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## Volume IV

East Central Oklahoma State Univ, Ada

Prepared for

Robert S Kerr Environmental Research Lab, Ada, Okla

May 77

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Environmental Protection Technology Series

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Management and research information on animal wastes has expanded rapidly in recent years. This material has appeared in such diverse sources as journal articles, conference papers, university publications, government publications, magazine articles, books or book chapters, and theses. This bibliography was compiled in order to speed the flow of information on findings in one segment of the livestock industry to other segments that could benefit from this technology.

Included in this publication are the following indexes: (1) author, (2) animal information categories. These indexes are followed by a section of abstracts of each reference entry found in the bibliography. Single copies of most articles can be obtained in hard copy or microfiche form at cost from the Animal Waste Technical Information Center, School of Environmental Science, East Central Oklahoma State University, Ada, Oklahoma 74820.

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# LIVESTOCK AND THE ENVIRONMENT

## A Bibliography with Abstracts

## Volume IV

by

M. L. Rowe
Linda Merryman
Animal Waste Technical Information Center
School of Environmental Science
East Central Oklahoma State University
Ada, Oklahoma 74820

Grant No. R801454-04

Project Officer

R. Douglas Kreis
Robert S. Kerr Environmental Research Laboratory
Ada, Oklahoma 74820

ROBERT S. KERR ENVIRONMENTAL RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
ADA, OKLAHOMA 74820

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# FOREWORD

The Environmental Protection Agency was established to coordinate administration of the major Federal programs designed to protect the quality of our environment.

An important part of the agency's effort involves the search for information about environmental problems, management techniques and new technologies through which optimum use of the nation's land and water resources can be assured and the threat pollution poses to the welfare of the American people can be minimized.

EPA's Office of Research and Development conducts this search through a nationwide network of research facilities.

As one of these facilities, the Robert S. Kerr Environmental Research Laboratory is responsible for the management of programs to: (a) investigate the nature, transport, fate and management of pollutants in groundwater; (b) develop and demonstrate methods for treating wastewaters with soil and other natural systems; (c) develop and demonstrate pollution control technologies for irrigation return flows, (d) develop and demonstrate pollution control technologies for animal production wastes; (e) develop and demonstrate technologies to prevent, control or abate pollution from the petroleum refining and petrochemical industries; and (f) develop and demonstrate technologies to manage pollution resulting from combinations of industrial wastewaters.

This report contributes to the knowledge essential if the EPA is to meet the requirements of environmental laws that it establish and enforce pollution control standards which are reasonable, cost effective and provide adequate protection for the American public.

William C. Galegar
Director
Robert S. Kerr Environmental
Research Laboratory

# ABSTRACT

Management and research information on animal wastes has expanded rapidly in recent years. This material has appeared in such diverse sources as journal articles, conference papers, university publications, government publications, magazine articles, books or book chapters, and theses. This bibliography was compiled in order to speed the flow of information on findings in one segment of the livestock industry to other segments that could benefit from this technology.

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This report was submitted in fulfillment of Grant Number R801454 by the School of Environmental Science, East Central Oklahoma State University, Ada, Oklahoma under the sponsorship of the Environmental Protection Agency. The work was completed as of January 31, 1977.

CONTENTS

Abstract . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . iii
Acknowledgements . . . . . . . . . . . . . . . . . . . . . . . . . . vi

1. Introduction . . . . . . . . . . . . . . . . . . . . . . . . 1
2. User's Guide . . . . . . . . . . . . . . . . . . . . . . . . 3
3. Author Index . . . . . . . . . . . . . . . . . . . . . . . . 7
4. Animal Information Category Index . . . . . . . . . . . . . . 29
5. Abstracts . . . . . . . . . . . . . . . . . . . . . . . . . 58

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The project staff extends its gratitude to the authors and publishers for use of their publications in these bibliographic entries. Work contributed by Laurin Patton, Assistant Professor in the School of Environmental Science at East Central Oklahoma State University, is deeply appreciated. Special thanks is also extended to EPA Project Officer R. Douglas Kreis for his assistance in the preparation of this bibliography.

# SECTION 1

## INTRODUCTION

Evolving regulations and aims pertaining to pollution abatement and control have necessitated a timely and well-dispersed flow of pertinent information concerning animal waste management so that capital investments in the animal production industry can be made on the basis of the most recent research and operational findings. In many activities, industrial and manufacturing organizations or associations provide the linkage channels through which such information may flow. The wide range in operation sizes and makeup, the geographic distribution of production units, the variations in climatic and geographic factors, and the dictates of the local or regional markets make widespread dissemination of animal waste management information difficult even through the established communication networks such as breed associations, farm organizations, and the popular agricultural press. Common properties and characteristics of animal wastes enable technological transfers to occur in the production operations from one species to another. Publicizing practices of findings in one segment of the livestock production industry can spread new ideas and techniques to other segments of the industry.

The objective of this project is to facilitate the dissemination and technological transfer of information on the management and disposal of animal wastes throughout the livestock industry. Identification and location of pertinent information generated in the production operations of poultry, swine, cattle, fish, and other animals of economic interest raised in open or confined systems is accomplished through searches of technical journals; books; theses; reports from private, state and federal agencies; papers given at meetings of professional societies or symposiums; and articles appearing in the trade or production-oriented "farm" magazines.

The search topics of specific interest include the physical and chemical characteristics of animal wastes (manures and manure contaminated materials); the operational and cost aspects of handling, collection, treatment, storage, transport, utilization, and disposal of animal manures; and the economic and legal impact of these wastes on the problems of air, water, and solid waste pollution. The articles identified in the search are collected and reviewed to determine if the contents are relevant to the project objectives. Those articles that are considered to be of value for the livestock producer or research scientist engaged in animal waste activities are abstracted and added to the collection.

An updated bibliography of animal waste management information is prepared annually. It contains entries and abstracts for all new items maintained in the collection at the Animal Waste Technical Information Center.

It is anticipated that users of this bibliography will secure pertinent publications from local libraries or through interlibrary loan. However, single copies of most publications (those for which copying approval has been obtained from copyright owners) may also be obtained upon request in hard copy or microfiche form at a cost-only fee from the following address:

Mrs. Linda Merryman, Project Librarian
Animal Waste Technical Information Center
School of Environmental Science
East Central Oklahoma State University
Ada, Oklahoma 74820

# SECTION 2

# USER'S GUIDE

The entries in this bibliography have been assigned a specific cross reference code. The code number consists of nine digits (example: 200-74-2458) arranged in the sequences of a three-digit class code, a two-digit number representing the year of publication or presentation, and a four-digit accession number identifying each article brought into the animal waste information collection. The first grouping identifies the class code of the document according to the following format:

| Code | Class |
|---|---|
| 100 | Technical journal paper |
| 200 | Conference proceeding paper |
| 300 | University or government publication |
| 400 | Magazine article |
| 500 | Book or chapter from a book |
| 600 | Unpublished paper |
| 700 | Thesis |

This publication consists of three sections: Author Index, Animal Information Category Index, and Abstracts. An explanation of each section follows.

## AUTHOR INDEX

This index lists all the authors cited in the bibliography in alphabetical order. To the right of each author entry is the cross reference code of the article or articles with which he is identified. An example of the format is as follows:

| | |
|---|---|
| ADAMS J L | 200 63 2157 |
| | 300 61 2326 |
| ADAMS R L | 300 74 2572 |
| | 400 71 1899 |
| ADRIANO D C | 100 73 2121 |
| | 100 74 2242 |
| | 200 74 2144 |
| ALBIN R C | 300 71 1739 |
| | 200 70 1805 |
| | 300 74 2219 |

## ANIMAL INFORMATION CATEGORY INDEX

To provide a quick entry into the abstract holdings of the collection, an animal information code was developed. This code utilizes an alphabetical entry to signify a broad interest area and a numerical digit to designate a more specific topic under the broad interest area. Each abstract in the collection is classified according to this code and could be listed under the most relevant categories. This provides the user with an easy entry into the abstract holdings pertaining to his information needs. An outline of the categories of information may be found on the next page.

CATEGORIES OF ANIMAL INFORMATION

| Interest Area | Topic Area |
|---|---|
| A. Environmental Effects | 1. General |
| | 2. Surface Runoff from Animal Production |
| | 3. Surface Runoff from Agricultural Watersheds |
| | 4. Surface Water Pollution |
| | 5. Groundwater Pollution |
| | 6. Odor |
| | 7. Air |
| | 8. Soil Systems |
| | 9. Biocides |
| | 10. Vectors |
| | 11. Animal Health |
| | 12. Public Health |
| | 13. Aesthetics |
| B. Management of Animal Production and Confinement Operations | 1. General |
| | 2. Liquid Systems |
| | 3. Solid Systems |
| | 4. Storage |
| | 5. Management's Impact on Waste Characteristics. |
| C. Characteristics of Animal Wastes | 1. Physical |
| | 2. Chemical |
| | 3. Biological |
| D. Treatment Processes | 1. Physical |
| | 2. Chemical |
| | 3. Biological |
| E. Utilization and Disposal | 1. General |
| | 2. Land Disposal or Reuse |
| | 3. Recycling |
| | 4. By-Product Recovery |
| F. General | 1. Economics |
| | 2. Legalities |
| | 3. Policy Needs |
| | 4. Overviews |
| | 5. Related Agricultural Operations |
| | 6. Research and Development |

The entries in the Animal Information Category Index appear by accession number under the code number as found in the following example:

C1
1664
1689
1710

## ABSTRACTS

This section contains the abstracts of the information entries contained in the bibliography. Many of these abstracts have been published in Selected Water Resources Abstracts published by the Water Resources Scientific Information Center. Each entry includes the title of the informational material, the bibliographic citation, the author or authors, keyword identifiers and descriptors, and the abstract. The abstracts are arranged sequentially by an assigned accession number which specifically identifies the article in the collection.

# SECTION 3

# AUTHOR INDEX

# AUTHOR INDEX

A S A E 200 73 1323
200 74 3379
ABBOTT E L 400 73 1341
ABBOTT F D 400 68 0038
ABBOTT J L 300 68 0256
100 68 0370
100 73 1162
ABDEL-MALIK S H 100 73 3299
ABELES T P 200 75 2912
ABERCROMBIE J C 700 71 2780
ABSHIRE R 100 71 0722
AD HOC COMMITTEE 300 72 3084
ADAMS D F 100 69 0310
ADAMS G H 300 75 3043
ADAMS J B 200 72 1274
ADAMS J L 100 65 0066
200 64 1700
200 63 2157
300 61 2326
ADAMS R L 400 71 2572
ADAMS S N 100 73 1653
100 73 1654
100 74 1655
100 73 3031
100 75 3225
ADAMS W E 400 69 2540
ADDISON J N 400 70 0357
ADOLPH R H 100 70 0340
400 71 0350
ADRIANO D C 100 71 0450
200 71 0830
400 71 1899
100 74 2082
100 73 2121
200 74 2144
100 74 2242
200 75 2688
ADRIANO D S 100 75 2422
AGENA U 200 72 1270
300 71 1476
600 68 1862
700 68 2310
AGNEW R W 200 66 0139
AGRI RES COUNCIL 300 76 3093
AHLERS R 200 75 2730
AHO W A 200 75 2754
AIKMAN J 300 72 1647
AKERS J B 200 75 2722
ALAGARSAMY S R 100 72 2550
ALBERT A WEBB ASSOC 500 74 1565
ALBERTS E E 600 75 3506
ALBIN R C 100 69 0071
200 69 0165
200 69 0183
200 70 0232
600 70 0255
600 70 0258
300 71 0538
100 71 0758
300 69 1180
200 72 1296
300 71 1739
300 1792
200 70 1805
300 74 2219
200 75 2648
ALBRIGHT J L 200 66 0126
200 75 2621
ALBUS JR C J 200 73 1082
ALDRICH R A 200 75 2693
ALDRICH S R 300 71 1035
200 73 2442
ALETI A 600 74 1568
200 74 1997
300 76 3042
ALEXANDER E L 200 71 1932
ALEXANDER R M 100 71 0454
ALGIN R C 200 73 1789
ALI G 200 75 2920
ALLEE D J 200 69 0203
ALLEE G L 300 2496
200 75 2637
ALLEN J B 600 71 0288
600 74 1749
600 74 1757
300 73 1784
200 72 1908
ALLEN J L 400 74 2095
ALLEN M D B 100 76 3189
ALLEN W S 600 73 1147
ALLISON J M 600 73 1815
ALLRED E R 600 70 0098
200 66 0154
200 69 0178
200 71 0836
300 69 1125
300 73 2384
200 75 2732
ALPHIN J M 200 72 1108
300 75 3179
ALTIMIMI A A 100 65 0066
700 63 2553
ALVERSON R M 100 71 0721
AL-ZAKRI A S 600 72 1163
AMEMIYA M 500 70 0389
AMENTA J S 100 70 0034
AMES G C W 100 76 3207
AMMERMAN C B 100 73 1190
AMOOZEGAR-FARD A 100 75 3260
ANDERSEN J R 200 64 0750
ANDERSON A W 300 74 2248
200 75 2689
ANDERSON C D 200 73 2101
ANDERSON C R 100 75 3334
ANDERSON D F 200 71 0821
200 72 1269
ANDERSON D P 100 68 1579
ANDERSON E D 400 70 0415
400 72 1166
400 72 2375
400 72 2376
ANDERSON F N 100 73 1800
ANDERSON J M 200 75 2749
ANDERSON J R 100 70 0013
200 66 0119
100 69 0373
100 75 3112
ANDERSON L L 300 72 1571
ANDERSON R H 200 75 2756
ANDERSON W F 100 75 3328
ANDRE C E 100 73 2249
ANDRE P D 400 74 1345
400 73 1374
100 73 1587
400 74 1590
400 74 2065
400 76 3168
400 76 3348
ANDREW F W 600 72 1886
ANDREW H 600 71 1729
ANDREWS F N 100 61 1390
ANDREWS J W 100 74 2404
ANDREWS L D 300 73 1620
ANTHONISEN A C 200 71 0821
600 74 1686
200 74 2016
200 74 2026
700 65 2128
100 74 2223
ANTHONY D W 100 61 1670
ANTHONY W B 200 66 0146
200 69 0171
100 70 0418
100 70 0723
200 68 0725
100 71 0751
200 71 0845
100 69 1316
100 62 2535
200 75 2654
ANTONIE R L 200 69 0056
APPELL H R 300 71 1081
300 70 1084
200 72 1359
100 72 2329
AREF D 300 75 2411
AREF J 600 73 1365
AREF K 200 74 2034
ARIAIL J D 200 71 0811
ARIALL J D 700 70 0231
ARKIN G F 600 72 1875
ARMBRUST D V 400 74 3518
ARMSTRONG A E 200 71 0614
ARMSTRONG D E 500 70 0405
ARMSTRONG D W 100 72 2811
ARNOLD H L 600 74 1757
300 73 1784
ASAE 200 66 0115
ASHCRAFT M 300 74 2042
ASHFIELD 400 75 2344
400 74 2418
400 76 3137
ASHRAF M 600 73 1499
ASIA RES PTE LTD 500 74 2503
ATTOE O J 100 70 0021
200 66 0116
100 71 0571
300 68 1122
100 70 2381
AUST A 200 64 1704
AVAULT J W JR 400 74 2232
AVERY G L 100 75 3206
AXLEY J H 200 71 0857
AXTELL R C 100 70 1853
200 75 2588
AYERS R S 200 73 1895
AZEVEDO J 100 74 2253
100 75 2272
300 74 2883
BABB M R 100 72 1553
BACHE D H 200 70 0114
200 75 2636
300 75 2874
BACKER D S 700 73 1652
100 76 3421
BACKER L F 600 73 1952
700 72 2316
BACKHURST J R 100 74 2775
400 73 3099
BACON C M 200 71 0705
600 72 1153
BADALICH J P 200 69 0544
200 69 0551
BADGER C 300 75 3322
BADGER D D 200 71 0819
300 70 1192
200 75 2592
BAIER D 300 1767
200 74 2033
300 72 2292
BAIER D C 600 73 1365
200 74 2034
300 75 2411
BAILEY E M JR 600 69 1006
BAILEY J W 600 69 1239
BAIN R C JR 300 70 0491
BAINES S 200 70 0252
100 73 1905
200 75 2742
BAKER D E 100 75 2265
BAKER D H 100 69 0361
100 73 1437
200 73 2278
BAKER D R 700 73 2379
BAKER J M 300 72 2522
BAKER M 200 69 2383
200 75 2594
BAKER R C 100 73 1402
BAKHATI H K 100 73 3299
BAKIR A K 200 75 2754
BAKKER-ARKEMA F W 600 73 2052
BALAKRISHNAN S 200 71 0818
BALDWIN B 200 71 0795
BALDWIN L B 200 71 0782
200 73 1328
200 75 2737
400 75 3347
100 75 3448
BALDWIN K A 300 71 1056
BALLARD R J 600 75 3202
BALLOUN S L 100 75 2427
100 75 2536
BAMESBERGER W L 100 69 0310
BANDEL L S 700 69 1734
BANWART W L 100 75 3090
BARBER E M 300 72 1425
300 74 2940
BARFIELD B J 200 71 1096
400 72 2415
BARKER B 200 69 0552
BARKER J C 600 72 1398
100 73 1574
100 73 1639
300 74 1782
200 75 2633
300 75 3176
BARKER R J 100 75 3328
BARLOW E W R 300 74 1959
200 75 2919
BARNEBEY O L 200 64 1694
BARNES C J 100 75 3001
BARNETT A P 400 69 2540
BARQUEST G D 300 74 2118
BARR G 300 74 1619
BARR H T 100 69 0360
BARRE H J 200 71 0769
BARRETT F 200 70 0242
100 71 2092
BARRINGER R 100 72 1960
BARTELS K H 200 73 2444
BARTH C 600 70 0469
200 69 0525
BARTH C L 200 71 0840
600 72 1002
600 72 1004
200 73 1329
200 71 1547
200 74 2023
100 74 2045
100 73 2332
600 75 2546
200 75 2587
200 75 2611
300 75 2829
200 73 2953
600 76 3238
600 75 3332
200 74 3391
200 74 3394
300 74 3419

# AUTHOR INDEX

BARTH C L 100 76 3486
100 76 3488
BARTH C N 200 75 2741
BARTH J 200 75 2685
BARTLESS R J 100 72 1480
BARTLETT H D 600 70 0080
200 71 0834
200 72 1299
600 73 1623
200 75 2616
200 75 2673
200 75 2696
100 76 3192
600 74 3516
BARTROP T H C 200 70 0239
BATEMAN T W 200 72 1303
300 74 1758
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BATES D N 400 71 0264
BATES D W 200 69 0706
600 72 1150
200 73 1324
400 74 1816
400 74 1994
100 73 2514
100 71 2762
400 75 2853
BATEY T 100 73 1069
100 72 2796
BATTELLE MEM INST 300 69 2099
BAUER L L 300 73 2860
BAUGH E R 200 73 1317
BAUGHMAN G R 100 74 1525
BAULING D H 600 73 1397
BAUMAN E R 100 65 2450
BAUMANN E R 100 70 0102
500 70 0407
100 64 0474
100 63 2549
100 63 2581
BAXTER S H 200 70 0251
100 68 0381
200 71 0825
BAYLEY H S 100 70 0027
100 70 0367
BAYLEY N D 100 70 0365
200 71 0763
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BEANE W L 100 75 2838
BEAR F E 300 48 2414
BEARD F L 100 73 3009
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300 73 1784
BEATTY M 300 72 3082
BEATTY M T 200 69 0523
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BECK J R 300 75 3056
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BEEFLND INTERNATL IN300 71 3115
BEER C E 100 70 0458
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BEGIN J J 200 71 0797
200 71 0860
600 72 1709
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BEIRNE B 100 75 3222
BELKO J 100 68 0296
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100 71 0729
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100 71 1902
100 72 2186
100 69 2380
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100 73 2779
100 71 2787
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BELLMAN H E 200 73 1334
BELLO T R 100 70 0270
BELYEA D A 200 75 2658
BENDIXEN T W 200 66 0438
300 72 3077
BENHAM C L 600 72 1595
BENNE E J 300 71 0630
BENNETT A 200 71 1452
BENNETT F W 300 76 3042
BENNETT G E 200 67 2281
BENTLEY G R 100 72 2789
BERG C W 600 73 1385
700 72 2568
BERGDOLL J F 200 72 1288
200 74 1871
BERGDOLL J F 200 75 2695
BERGE O I 400 71 0262
400 71 0267
200 69 0524
BERGLUND S 200 75 3185
BERGMAN E L 300 71 0412
200 71 0783
300 76 3004
BERGSRUD F G 700 67 2228
BERGSTROM P D 700 71 2308
BERKOWITZ J 100 69 0736
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BERNARD H 100 70 0051
200 69 0160
500 70 0411
300 70 0492
200 69 0565
200 71 0603
300 3362
BERNARD L R 200 66 1112
BEROZA M 100 70 1090
100 70 18[illegible]
BERRY E C 200 66 0132
BERRY G 100 67 0041
BERRY J G 400 71 1482
200 74 2007
400 71 2237
BERRY O J 200 75 2626
BERRY P S 200 70 1050
BERRYMAN C 200 70 0237
100 73 1069
100 72 2796
200 68 3479
BERTRAND A R 100 71 0509
BERVEN B B 100 75 2410
BESLEY H E 200 70 2399
BETHEA R M 100 72 1188
100 72 1621
BEVILLE B 200 70 0755
BEZDICEK D F 200 75 2674
BHAGAT S K 100 69 0030
BHALERAO B B 100 72 2550
BHARGAVA K K 100 75 3000
BHATTACHARYA A N 200 66 0145
100 66 0422
100 65 1079
100 75 2986
BHUMBLA D R 100 73 3459
BIAVATI B 100 74 2923
BIELBY D G 400 73 1073
100 73 2812
BIELBY D G S 700 70 2455
BIELY J 100 72 2509
100 76 3422
100 75 3523
BIGBEE P D 100 73 1660
BIGGAR J W 100 66 0063
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BINIEK J P 200 69 0198
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BIRD H R 100 48 2400
BISHOP E J B 100 71 2760
100 71 2761
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200 75 2624
300 73 2867
BISSONNETTE G K 100 71 1212
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BLACK C A 500 70 0391
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BLACK R J 200 69 0517
200 63 2163
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BLACK S A 100 70 0083
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BLACKMAN W C 100 65 0378
BLACKMER A 200 72 1300
BLACKWELL C E III 100 74 3095
BLAIR B J 200 73 1510
300 72 1561
BLAIR J F 400 72 1943
400 75 2890
400 76 3285
BLAIR R 400 73 1549
200 74 1869
400 75 2425
100 73 3067
400 74 3329
400 73 3371
100 73 3469
100 74 3527
100 76 3528
BLANKEN G 100 71 2990
BLANKEN V G 100 70 2819
100 70 2823
BLASKA G 300 72 3083
BLETNER J K 100 73 1086
BLOBAUM R 100 75 3006
BLOODGOOD D E 200 69 0167
100 71 0588
200 64 1692
600 67 2198
BLOODGOOD T W 200 66 1644
BOCK B R 300 74 1783
BOCK W R 400 76 3433
BODA J C 300 76 3160
BODENHAMER S H 200 69 0566
BODINE A B 100 74 2502
BODMAN G R 600 76 3253
BODY D A 100 73 1069
BOEDICKER J J 600 73 2557
300 73 3498
BOERSMA L 300 74 1959
200 75 2631
400 75 2814
300 74 2833
200 75 2919
600 75 3022
BOESCH B E 600 73 1682
200 74 2137
BOHLEY P B 200 75 2702
BOLAND H 200 73 2445
BOLING J A 100 71 0441
100 71 0462
100 73 1263
BOLSTAD I 300 72 3085
BOMKE A A 200 75 2757
BOND J 400 74 2776
BOND J H 200 75 2587
300 75 2829
BOND T E 100 70 00[illegible]4
200 66 0125
200 71 0777
200 72 1024
200 75 2709
BONDURANT D T 600 71 1730
BONNEAU W R 100 73 1558
BOORAM C V 600 73 1065
200 73 1526
200 74 2005
200 74 2031
200 75 2738
100 75 3017
100 74 3021
600 75 3214
BOORAM C V JR 700 71 1762
BOPANDIKAR M V 200 69 1102
BORDEAUX A F JR 200 71 1094
BORDNER R H 100 62 0382
BORNE B J 100 70 0089
400 64 0358
BOS R E 600 73 1623
BOSCH J A 600 74 1543
BOSLEY P 300 71 2451
BOSTON W D 600 73 1397
BOTTCHER A B 600 76 3278
BOULDIN D R 200 71 0648
200 72 1304
200 74 2009
100 76 3109
BOUSFIELD S 200 75 2740
300 3010
100 74 3092
400 73 3536
BOUWER H 100 68 0481
BOWDEN J P 600 76 3278
BOWEN W R 300 75 2545
BOWLAND J P 100 71 2551
BOWMAN P C 100 70 1090
100 70 1823
BOX J E JR 100 73 1450
BOYCE J 700 70 1779
BOYD J 300 74 2555
BOYD J C 300 74 3154
BOYD J S 300 70 0208
200 71 0815
300 72 2561
BOYLE W C 100 70 1230
BRAASCH M 100 69 1461
BRADLEY J 600 73 1521
BRADLEY J W 400 69 1523
BRADLEY M 400 65 0485
BRADLEY N W 100 71 0441
100 71 0462
100 73 1263
BRADY N C 200 70 0322
BRAIDS O C 300 70 0475
BRAMBLETT J 400 76 2938
BRAMHALL E L 400 71 0568
BRANCH J W JR 200 75 2623
BRANDENBERG B 200 74 2018
BRANDING A E 200 75 2616
BRANNIGAN P G 100 71 2200
BRATZLER J W 200 69 0170
100 70 0413

# AUTHOR INDEX

BRAUD J 600 72 1154
BRAUN D 400 72 2046
BRAY R W 200 69 0522
BREEDEN G C 100 75 2838
BREMNER J M 100 75 3090
BRENDER M 200 64 1702
BRESSLER G O 100 70 0025
100 70 0107
400 71 0311
300 71 0412
200 71 0783
200 71 1405
200 69 1981
400 72 2036
100 73 2259
200 70 2391
600 72 3111
BRETHOUR J R 100 60 1677
BREVIK T 300 72 3088
BREVIK T J 200 69 0524
200 73 1331
200 73 1332
200 73 1531
400 73 1634
400 73 1740
200 71 1975
300 74 2118
BRICKER C E 200 72 1275
BRIDGHAM D O 200 66 0135
BRINCK C W 200 70 1175
BRINK N 100 75 2965
BRISBIN I L 300 71 1126
BRISCOE E R E 100 69 1485
BRITT C S 500 70 0386
400 69 1225
BROCK W 400 71 1899
BRODIE H L 300 68 0352
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300 72 2104
200 75 2629
200 75 2906
BROMEL M 200 71 0795
BROMEL M C 200 71 0641
200 75 2679
BROMMENSCHENKEL F JR 300 74 2044
BROOKER D B 100 70 0678
BROOKS L A 200 69 0524
200 73 1531
BROOM D M 100 75 3072
BROWN C M JR 200 66 0126
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BROWN E E 600 72 1995
BROWN J B JR 200 75 2914
BROWN J H 300 72 2063
BROWN J R 300 65 0739
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BROWN R H 400 73 1633
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400 74 2172
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400 75 2857
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400 76 3303
400 76 3350
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BROWN W B 100 73 1828
BROWN W O 100 69 0364
BROWNING C E 600 73 1445
BRUNS E G 200 69 0524
300 72 1524
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BRUSEWITZ G H 600 72 1581
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BRUST R A 100 71 1223
BRYANT M P 200 71 0669
BRYANT R 200 74 2464
BRYDON H W 100 67 0501
BUBENZER G D 600 74 1712
200 74 1777
200 75 2672
600 75 2889
BUCHANAN L C 100 75 3429
300 74 3522
BUCHANAN M L 100 69 0035
200 71 0640
600 73 1385
600 74 1847
600 73 1852
200 75 2701
BUCHANAN S P 200 75 2632
BUCHER B L 200 72 1354
BUCHOLTZ H F 300 71 0627
200 71 0849
BUCKLEY J L 200 72 1266
BUCKNER D H 200 75 2696
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BULL L S 200 71 0846
300 65 2267
BULLARD W E JR 400 68 0032
BULLEY N R 200 71 0801
200 71 0822
BUNDY D S 200 74 2005
BUNGER R E 200 74 2469
BUNTEN H A 300 71 1879
BUNTING A H 100 65 0377
BURBEE C R 300 74 2177
BURKHEAD C E 300 74 2827
300 74 2828
BURNETT G A 200 75 2740
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BURNETT W E 100 70 0019
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100 71 0314
100 69 0363
100 69 0508
300 69 0631
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300 69 0637
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BURNS J C 200 75 2753
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BURR T 200 74 2458
BURT J P 600 76 3281
BURTON C H 300 72 2522
BURWELL R E 600 75 3506
BUSCEMI P A 100 69 1198
BUTCHBAKER A 200 75 2719
BUTCHRAKER A F 200 71 0705
200 71 0733
200 71 0779
200 72 1152
600 72 1153
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600 72 1262
200 72 1295
100 73 1339
200 72 1528
600 72 1575
600 72 1581
100 74 1951
600 72 1992
300 2117
200 74 3381
300 75 3424
BUTLER J F 100 73 3035
BUTLER R G 300 69 0735
BUTLER R M 200 74 1527
600 73 1848
BUXTON B 100 73 2895
BUXTON B M 200 74 2001
200 75 2599
BYERLY C S 100 76 3301
BYERLY T C 200 71 0611
BYINGTON C 300 74 2173
BYINGTON K C 700 75 3094
BYRKETT D L 200 75 2596
100 76 3443
BYRNE E 100 74 2988
CABES L J JR 100 69 0360
CAHILL T A 100 74 2253
CAIN J M 200 71 1967
CALDWELL R L 300 71 2077
CALDWELL T H 100 73 1069
CALLANTINE M R 100 61 1390
CALVERT C C 100 70 0028
100 70 0082
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300 71 0512
200 70 0716
200 71 0852
200 73 1093
300 70 1388
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CAMPBELL R S 500 70 0406
CANADA ANIMAL WASTE 300 72 1157
CARDON B P 200 72 2279
CARDON D R 300 71 1598
CARLILE B L 300 2085
700 72 2448
CARLISLE G R 600 72 2122
CARLOS A 700 73 2972
CARLSON D A 200 69 0191
200 66 0587
CARLSON H C 100 68 1469
CARLSON J 400 76 3110
400 76 3170
400 76 3442
CARLSON K H 100 70 0367
CARLSON L G 200 71 0785
CARMODY R 400 64 2793
CARO J H 300 75 2880
CARPENTER P M 300 73 2865
CARREKER J R 100 73 1450
CARROLL J J 300 74 1602
CARROLL R 300 72 3117
CARSON J R 100 69 0040
200 74 2007
CARTER G R 300 72 1182
CARTER T A 100 73 2259
CASE A A 300 64 1786
CASLER G L 200 69 0202
300 72 1506
300 72 1802
200 74 2010
200 75 2598
200 75 2910
CASON R G 300 73 3408
CASSELL E A 200 66 0140
100 70 2794
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CASSELMAN T W 200 74 2971
CASTLE M E 100 72 3032
CASWELL L F 100 75 2244
300 74 2527
200 75 2652
300 75 3351
300 75 3355
CATE C A 200 75 2659
CATH S 200 71 0765
CATH W S 200 71 0596
CAVIN L M 300 71 1057
CENA M 500 75 3248
CERRILLO L A 300 75 2339
CHALOUPKA G W 100 68 0036
200 69 1824
CHAMBERLAIN W F 100 75 3201
CHAMBERS C W 200 64 1703
CHANG A C 200 69 0176
200 71 0838
600 73 1365
700 71 1668
200 74 2034
300 71 2062
100 74 2082
100 73 2121
100 74 2242
300 75 2411
100 75 2422
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200 75 2624
200 75 2686
CHANG T S 300 72 1182
200 74 2004
200 75 2605
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300 75 3062
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CHAPPELOW C C 300 75 2980
CHARLES D R 100 66 0479
CHARLES O W 400 70 0109
100 73 1315
CHARLOCK A H 100 71 2241
CHATER M 100 73 2521
CHEE K M 300 75 3055
CHEN J J J 100 74 3473
CHEN S K 200 75 2656
CHEN Y R 200 75 2736
600 75 2878
100 76 3445
100 76 3485
100 76 3491
600 75 3507
600 75 3517
CHERMS F L 100 68 1579
CHESNESS J L 600 74 1608
300 74 1782
600 72 1995
600 73 2848
CHESNIN L 600 71 0100
100 74 2515
100 75 2891
400 76 3136
CHIANG H 300 73 2355
600 74 2356
CHIANG H C 100 70 0421
CHICCO C F 100 73 1190
CHICHESTER F W 200 71 0774
CHILD R D 300 65 2558
CHIU S Y 600 74 1568
200 74 1997
300 76 3042
CHOI S K 100 71 1936
700 69 2060
100 72 2170
CHRISTENSEN L R 700 73 1890

# AUTHOR INDEX

CHRISTENSEN P 200 73 2438
CHRISTENSEN R D 300 72 3026
CHRISTENSEN R L 600 73 1499
300 74 2042
200 75 2591
CHRISTENSON E H 100 71 0444
CHRISTENSON L R 100 73 1558
CHRISTIANSON A G 100 69 0375
CHRISTY M 300 65 0739
CHUANG F S 700 71 1791
CHUMNEY R D 400 71 0446
CHURCH D C 200 76 3468
100 76 3509
CIORDIA H 200 75 2664
CIRABOLO D L 300 75 3357
CIRAVOLO T G 300 74 2528
200 75 2675
CLARK C E 100 65 0075
600 64 2201
CLARK D A 200 75 2685
CLARK F E 300 67 1250
100 72 1540
CLARK H F 100 62 0382
200 64 1240
CLARK J M 200 70 0220
CLARK R N 200 73 1512
600 74 1756
200 75 2671
200 75 2711
100 75 2900
CLARKE N A 100 66 1344
200 64 1703
CLAUDON D G 100 71 0444
CLAVEL P 200 69 0203
CLAWSON W J 100 71 0680
CLAY A M 100 73 1832
CLAYBAUGH J W 400 70 1477
400 71 2276
CLAYTON J T 200 66 0134
200 66 0135
200 69 0168
300 71 0732
200 71 0858
600 72 1993
200 70 2395
CLAYTON W 200 69 0540
CLAYTON Y M 100 71 0567
100 71 2767
CLUSEN MRS D 200 71 0275
CLYMER B C 300 73 1471
COCHRAN D M 200 71 0284
COE W B 200 72 1355
200 72 1359
COFFMAN B 400 74 1809
COLE C A 200 75 2696
100 76 3192
COLE G D 200 71 0792
COLEMAN D C 300 71 1126
COLEMAN E 300 1792
COLEMAN E A 200 70 0232
300 71 0538
300 69 1180
200 72 1296
300 71 1739
200 71 1928
200 72 2174
COLEMAN T H 100 70 0020
COLLIER A 400 73 2338
COLLINS E R JR 300 74 2528
200 75 2675
600 75 3277
300 75 3357
300 75 3359
COLLINS N E 200 75 2698
COLLINS R K 300 71 1238
COLMER A R 100 69 0360
100 70 0420
100 73 1164
COLO DEPT OF AG 300 73 2844
COLO DEPT OF HLTH 300 68 0741
COLYER D 200 72 1273
COM ON GOVERN OPERA 300 74 1606
COMBS G E 300 75 2852
CONCANNON T J 200 71 0832
CONNER L J 200 74 2013
CONNOR J K 100 64 0072
CONNOR L 200 74 2000
CONNOR L J 200 71 0789
200 72 1272
200 73 1326
300 73 1501
300 71 2080
300 73 2516
300 72 2561
200 75 2593
200 75 2595
300 75 2936
CONRAD J H 100 71 0683
CONRAD R D 200 71 0598
CONVERSE J C 300 70 0009
CONVERSE J C 200 69 0074
200 69 0078
200 69 0177
100 69 0353
300 68 0749
200 71 0837
600 72 1156
400 73 1178
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600 72 2195
300 74 2215
100 73 2218
200 73 2434
200 75 2672
200 75 2712
600 75 2889
600 75 2894
200 74 3383
COOK R J 100 76 3190
COOKE G W 100 70 1233
COOLEY C E 200 66 0144
COOPER C 400 73 1607
COOPER D P 300 74 2217
COOPER H B H 200 74 1500
COOPER J B 100 76 3205
COOPER J E 100 75 2293
COOPER M M 200 70 0245
COOTE D R 300 75 3038
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CORLEY C 100 75 2881
CORNELL UNIV 200 74 1996
CORNFORTH I S 100 73 3143
100 74 3333
CORVINO C 200 75 2657
COSENZA B J 100 72 1516
COSTIGANE W D 300 72 2213
COTNOIR L J 200 69 1983
COUCH J R 400 74 1563
400 72 1836
200 74 1870
200 73 2548
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COX J 100 75 2945
COX J L 100 74 3290
COX N A 100 73 1164
CRABTREE K T 200 69 0482
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600 69 2179
CRAGG J 100 71 0567
100 71 2767
CRAINE L B 100 70 1211
CRAMER C O 600 72 1156
200 73 1331
200 73 1332
600 74 1738
400 73 1740
200 71 1977
300 74 2118
600 72 2195
300 74 2215
100 73 2218
200 73 2434
200 75 2712
CRANDELL R A 100 74 3268
CRAUER L S 200 73 1336
100 74 2403
200 75 2729
CRAWFORD D 300 72 2372
CRAWFORD D M 300 72 2374
CRAWFORD R E 600 69 1005
CREGER C R 400 73 1492
400 75 2349
400 76 2967
CRENTZ W L 200 71 2785
CROCIANI F 100 74 2923
CROCKETT B 200 69 0554
CROCKETT J R 200 74 2971
CROCKETT S P 600 74 1757
300 73 1784
CROMACK H T H 100 75 3458
CROPSEY M G 300 73 1474
300 72 2261
CROSBY III J W 100 71 1236
CROSS B S 300 71 0744
300 71 0745
CROSS D L 100 73 1263
200 75 3204
100 76 3447
CROSS F B 300 71 1057
CROSS F B 100 69 1461
CROSS G R 200 71 0819
700 71 2771
CROSS O E 300 70 0010
600 71 0100
200 66 0141
100 71 0318
100 70 0369
200 72 1021
600 74 1604
600 72 1843
300 71 2133
300 69 2797
300 74 2952
CROSSWHITE W M 300 74 2177
CROWE R 200 72 1310
CROWLEY J W 200 71 0664
300 72 1524
200 71 1979
CRUZAN D C 100 71 1491
CULLEY D D JR 100 73 1128
400 73 2429
CULLISON A E 100 76 3504
CULPIN C 400 64 0335
CUMMINGS G A 200 75 2753
300 74 2850
CUMMINGS R 600 75 3166
CUNDIFF L V 100 71 0462
CUNHA T J 400 76 3132
CUNNINGHAM A C 100 76 3504
CUNNINGHAM F E 400 75 2512
CURL T 400 76 3063
CURRIGAN D J 300 75 3061
300 75 3062
100 74 3288
CURRY N H 200 71 0767
CURTIS D R 200 66 0138
CURTIS J O 200 73 2435
CURTIS S E 200 73 2101
300 74 2832
100 75 3334
200 74 3367
CYWIN A 300 70 0492
300 71 0591
300 74 2825
DABER J W 200 75 2659
DAGUE R R 300 69 0062
300 69 0093
200 69 0425
200 70 0747
DAHM P A 500 70 0395
DALE A C 300 70 0008
200 66 0126
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600 73 1844
600 74 1845
300 71 2062
600 72 2074
600 67 2198
100 74 2541
200 75 2621
200 75 2627
200 75 2636
200 75 2731
DALE J L 300 71 0625
DALE R C 200 74 2027
DALRYMPLE W 500 72 3457
DAMRON B L 100 75 3048
DARDEN D W 400 74 1911
DARFLER J M 100 73 1402
DAS K C 200 72 1278
DAUGHERTY R V 100 72 1555
DAVEY C B 200 71 0805
DAVID G V 100 75 3012
DAVIDSON J A 200 66 0142
300 70 0206
DAVIES C K 200 75 2653
DAVIS B H 100 73 1164
DAVIS D E 200 69 1980
DAVIS E 300 70 1101
DAVIS E G 300 72 2063
DAVIS E H 200 66 0127
300 71 1879
DAVIS G A 200 74 1999
200 75 2597
300 74 3279
DAVIS H R 100 66 0473
600 72 1031
200 63 2159
DAVIS J F 100 73 2277
DAVIS K R 100 73 1087

# AUTHOR INDEX

DAVIS K R 400 73 1957
100 74 2256
DAVIS R 100 70 0023
DAVIS R E 200 64 1241
DAVIS R V 200 66 0144
DAVIS S 600 72 1148
200 72 2999
DAWES J H 200 71 1252
DAWSON R N 200 70 0720
200 71 0853
100 73 1450
DAY D L 300 70 0008
300 70 0009
200 69 0074
200 69 0078
100 68 0087
100 68 0106
200 66 0133
200 69 0177
200 70 0218
100 69 0353
100 68 0442
100 66 0478
100 71 0574
200 71 0669
300 71 0672
100 67 0713
300 68 0749
200 69 0756
300 65 0757
200 71 0837
200 71 0861
100 71 1047
200 72 1089
400 65 1142
600 73 1397
100 70 1429
100 73 1437
100 65 1573
600 73 1583
100 73 1635
600 71 1717
600 74 1949
200 74 2021
600 66 2194
600 64 2204
200 73 2278
400 74 2336
100 73 2342
200 73 2437
500 71 2524
200 75 2640
200 75 2644
200 75 2703
200 75 2731
300 72 2983
200 75 3114
600 75 3236
100 76 3289
100 76 3301
100 75 3334
200 74 3367
200 74 3396
200 74 3497
DAZZO F 100 73 1448
200 73 3533
DAZZO F R 700 72 2319
DE JONG A P S 200 70 0247
DE LAS CASAS E R S 100 70 0018
DEA S J 300 70 0489
300 70 0492
DEATON J W 100 71 0695
DECKER M 200 75 2727
DECKER M JR 200 72 1278
DECKER W M 200 66 0118
DEGOEIJ J J M 300 71 1100
DEMINT R J 500 70 0397
DEMMEL D 400 76 3155
DEMPSTER D G 100 71 3374
DENDALL J E 400 75 2877
DENDY M Y 100 68 0011
400 73 1854
DENIT J D 200 71 0603
200 71 0644
200 74 1998
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300 74 2825
300 74 3122
DENMEAD C F 100 72 2789
DENNISTOUN R M 200 71 0599
DENSMORE J 200 69 0531
200 71 1968
200 71 1971
300 72 3085
DENTON C A 100 48 2400
DEPT OF E&W RES ENG 100 69 0679
DEPT OF INTERIOR 300 72 3116
DEPT OF SCI&IND RES 300 62 0754
DESHAZER J A 600 71 0494
200 72 1442
DESHAZER J A 100 72 1913
200 73 2477
200 74 3365
DEVINE R J 600 74 3271
DEWEY A W 100 72 1516
DEWEY J E 200 71 0650
DICK E C 100 71 0444
DICKERSON J D 400 74 3518
DICKEY E E 600 75 2849
400 76 3331
DICKEY G L 600 69 1239
DIDIER P P 300 72 3080
DIESCH S L 500 70 0402
200 71 0836
100 73 1685
300 73 2384
200 75 2586
200 74 3363
200 74 3364
100 71 3541
DIETRICH G N 300 70 0488
DIETRICH R A 300 71 1261
DILLON W M 200 66 0126
DINIUS D A 300 71 0514
100 76 3425
DITTMAN A C 200 75 2662
DIXON J E 200 74 2004
200 75 2646
200 75 2721
300 75 3051
300 75 3061
600 76 3342
DOBBINS C N JR 200 75 2642
DOBIE J B 600 73 1803
DOBSON R C 100 70 0012
DOBSON S H 300 2085
DODD J D 200 71 0808
DODD V A 100 71 0688
100 73 2582
100 71 2782
100 74 2784
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DOLL R J 200 72 1267
DOMINICK D D 200 71 0595
DOMMERT A R 100 70 0362
DONDERO N C 100 70 0019
200 69 0190
300 69 0631
300 69 0637
200 74 2008
DONOVAN T J 100 74 2131
DORMAAR J F 100 75 3526
DORMINEY R W 600 1383
DORN D 300 75 3060
DORN D A 300 71 0625
300 71 0629
200 72 1289
DORN D S 100 74 3505
DORNBUSH J N 200 70 0054
200 64 0750
200 71 0773
300 73 1376
600 71 2839
100 75 3112
600 70 3410
DOROUGH H W 200 71 1095
DOSS B D 100 75 2352
200 75 2751
100 75 2884
DOUGLAS M P 200 69 0176
300 71 2062
DOUGLAS P 200 71 0276
DOUGLASS M P 700 71 1742
DOWDY R H 500 70 0388
DOWNER R N 600 75 3074
DOWNING A L 100 70 1194
DOWNING D L 200 71 0647
DOWNS W 200 74 1986
DOYLE R C 200 75 2674
DRAKE C L 200 66 0145
300 68 1948
DRAPER S R 100 71 2402
DRIELSMA A B 200 70 0227
DRIGGERS L B 300 73 1517
300 1546
300 2085
200 75 2630
100 74 2929
DRUMMOND J G 200 73 2101
DRUMMOND R O 100 63 1064
100 73 1467
DUBETZ S 100 75 3526
DUDZINSKI M L 100 73 1538
DUFFER W R 200 70 0698
300 71 1245
DUFFNER P F 700 74 2774
DUFFY M E 100 69 0265
DUGAN G L 300 70 0668
100 72 0746
100 73 1184
DUKE H R 200 74 1987
200 75 2711
DUMELLE J O 200 69 0526
DUNAVANT B G 100 73 1190
DUNBAR J R 300 74 1602
DUNCAN C 100 70 0340
DUNLOP S G 200 68 1244
DUNN B 200 75 2657
DUNN C 100 71 0291
DUNN G G 200 72 1308
DURAN A 100 70 0369
DURHAM R M 200 66 0147
DURING C 100 73 3417
DYAL R S 200 63 2161
DYER I A 100 55 0328
EASTBURN R P 200 75 2698
200 75 2746
600 75 2855
600 76 3305
EASTWOOD R E 100 67 0501
EBY H J 200 66 0149
200 69 0192
300 68 0352
400 66 0380
100 62 0499
200 70 0716
200 71 0852
300 72 1070
200 64 1696
600 72 1752
200 63 2156
300 63 2471
ECOTOPE GROUP 300 75 3511
EDDY G W 100 61 1669
EDWARDS C M 100 72 1557
EDWARDS D H 300 72 2213
EDWARDS H M JR 400 60 1596
EDWARDS J B 200 69 0179
EDWARDS N L 100 73 1449
EDWARDS R 200 68 0760
EDWARDS W M 200 71 0774
100 71 1039
100 70 1195
200 72 1283
100 72 1519
200 75 2706
EFFERTZ N 400 76 3428
EFTINK B 400 73 1387
400 74 1626
400 73 1778
400 74 2974
EGG R C 600 74 1751
EGON S 600 73 1364
EHLERS M H 100 70 1211
600 75 2896
EHMKE V 400 75 2893
EISENHAUER D E 600 73 1813
600 74 1888
700 73 3210
EISENMAN T W 200 75 2635
EL SERAFY A E F 300 72 2371
ELAM L 400 72 1439
ELAM M L 400 73 1168
ELDRED A R 100 75 3048
ELLAM D F 200 75 2742
ELLIOTT L F 200 71 0583
100 71 0589
200 71 0798
200 72 1013
100 72 1097
100 71 1312
100 72 1530
100 72 1536
100 73 1542
100 71 2424
100 73 2447
100 74 2491
100 75 2543
300 75 2837
200 74 3365
ELLIS B G 200 71 0827
200 72 1297
300 74 2388
ELLIS D 200 70 0227
200 72 1304
200 74 2011
ELLIS D F 100 76 3259
ELLIS J R 300 70 0010
200 70 0216
100 71 0318
100 71 0573
200 71 0775
200 71 0776
200 72 1016
100 72 1097
100 72 1129
200 72 1282
300 72 1314
600 74 1684
100 74 1821

# AUTHOR INDEX

ELLIS J R 100 75 2280
300 74 2331
300 75 2863
600 75 2869
100 76 3257
ELLIS L V 600 73 1463
ELMUND C K 200 75 2681
ELMUND F K 700 70 2406
ELMUND G K 200 69 0195
100 71 0273
200 71 0809
200 74 1988
ELRICK D E 100 66 0063
ELSON H A 600 72 1595
200 75 2607
EL-DOMIATY H A 600 75 3016
EL-SABBAN F F 200 69 0196
100 70 0413
EL-SHARKAWI F M 100 70 1040
EMERSON G 400 75 2116
400 75 2845
ENFIELD G H 200 69 1982
ENGBERG R A 300 67 0711
ENGLAND C B 100 73 1556
ENGLE B 600 72 2489
ENGLER C R 300 73 1372
300 73 1907
300 73 2498
300 74 2887
600 74 2984
ENGLISH P R 100 71 3374
END C F 300 66 1897
EPA 300 74 1346
300 72 1576
300 73 1785
EPPS E A 100 73 1128
ERB R E 100 70 0064
100 69 0693
ERDMANN A A 200 69 0520
ERHARDT W H 200 71 0833
ERHART A B 100 65 2423
ERICKSCN A E 200 71 0827
200 72 1297
300 74 2388
ERICKSON D B 300 70 0743
ERICKSON D O 600 73 1385
ERICKSCN L E 100 67 0104
100 70 0738
300 73 1372
300 73 1907
100 71 1936
100 72 2170
300 72 2313
100 74 3444
ERICKSON S 400 75 3098
ERNST J V 200 75 2664
ERNST S E 100 73 1467
ERSKINE F 200 71 1457
ESCHLE J L 100 75 3201
ESHELMAN R M 100 75 2265
ESKINS K 200 72 1354
ESMAY M L 300 71 0626
200 74 2004
600 73 2052
200 75 2605
200 75 2646
200 75 2721
300 75 3051
300 75 3061
600 76 3342
ESSIG H W 400 75 2345
EUERLE G O 200 75 2622
EUERLE W R E 200 75 2622
EVANS C E 200 69 0548
EVANS D 200 69 0519
EVANS G W 600 75 2894
EVANS J D 600 73 2557
EVANS M R 100 72 1224
100 73 1905
200 75 2742
EVANS N A 300 70 0490
EVANS S D 300 74 3102
300 74 3103
300 74 3104
EVANS S I 300 73 3498
EVERINGHAM R 200 71 0665
EVERSOLE J S 100 65 1091
EVERSOLE J W 100 65 1750
EWING S A 600 67 1683
FADIKA G O 300 75 3056
300 75 3058
300 75 3059
FAIR J F 100 67 1258
FAIRBAIRN C B 400 70 0029
FAIRBANK W 600 72 1148
400 71 1899
FAIRBANK W C 400 70 0097
200 66 0128
400 71 0568
300 74 1601
FAIRBANK W C 400 74 1827
100 74 2075
300 72 2533
400 75 2547
200 75 2624
300 73 2867
FAITH W L 100 64 2079
FALTER J 400 75 2834
FALTER J M 300 73 1517
300 1546
300 2085
FAN L N 300 72 2313
FAN L T 100 70 0738
300 73 1372
300 73 1907
100 71 1936
100 72 2170
300 73 2498
300 74 2887
600 74 2984
100 74 3444
FARLIN S 200 72 1017
FARLIN S D 300 74 2331
FARMER D M 300 73 1368
FARR F M 400 73 1492
FARRELL J B 200 71 1033
FASSBENDER C A 100 72 1199
FAULKNER G 400 70 0351
FEACHEM R 100 74 3232
FEASTER J P 100 73 1190
FEE R J 400 73 1674
400 75 3134
FEHR R L 200 74 2005
200 75 2713
FEHRENBACHER J B 300 71 1035
FELD I L 300 72 2063
FELDMAN M 200 71 0772
FELDMANN H F 100 73 1343
600 73 1746
200 73 2180
FENG T H 200 69 0168
FENLON D 200 75 2743
FENSTER W E 500 70 0394
FENTON R L 100 71 1236
FEREBEE D C 400 71 0505
FERGUSON T L 200 72 1275
FERNANDEZ R 100 73 1464
FERRELL C L 200 73 1062
FETH J H 100 66 1080
FETTEROLF J 400 72 1941
400 74 2202
FIELDS W J 700 71 1761
FILIP D S 100 75 2931
FILIPI T A 200 69 0547
200 69 0556
FINA L R 200 66 0120
100 67 0302
100 66 0506
200 66 1112
FINCHER G 100 75 3317
FINCHER G T 100 70 0023
FINSTEIN M S 100 69 0736
100 74 2327
FISCHBACH P E 100 72 1557
600 72 1843
FISCHER J R 200 75 2718
600 75 2902
200 75 2909
300 75 3027
FISH H 200 70 0240
FISHER L J 600 72 1901
200 74 2014
FLACHOWSKY G 200 75 3183
FLAHERTY D C 400 68 1884
FLAIM T 300 73 3120
FLEGAL C J 100 70 0020
300 70 0205
300 70 0209
300 70 0210
300 70 0211
300 70 0212
300 71 0623
300 71 0625
300 71 0627
300 71 0628
300 71 0629
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200 71 0848
200 72 1289
200 69 1840
600 74 1916
200 74 2004
200 75 2605
200 75 2646
200 75 2651
200 75 2721
300 75 3050
300 75 3051
300 75 3054
300 75 3056
FLEGAL C J 300 75 3059
300 75 3061
FLEMING B 400 74 1610
400 74 1917
400 76 3335
FLETCHER D W 100 55 0328
FLINT R C 100 74 2340
FLIPOT P 100 75 3477
FLOCCHINI R G 100 74 2253
FLORENCE A R 100 75 3524
FLORIDA 300 75 2888
FOEHRENBACH J 100 69 1231
FOERSTER E L SR 200 66 0148
FOGG C E 200 71 0770
FOLTZ V D 100 64 0345
FONTENOT J P 200 66 0145
100 66 0422
200 71 0847
100 65 1079
100 74 1950
100 75 2244
100 75 2419
300 74 2526
300 74 2527
200 75 2652
100 75 2830
300 74 2934
100 75 2943
100 75 3231
300 75 3351
300 75 3352
300 75 3353
300 75 3354
300 75 3355
FORD J P 200 75 2694
200 73 2949
FORDHAM H W 300 73 1367
700 74 3287
FORDYCE J 100 74 3261
FOREE G R 200 69 0180
FORREST U 300 75 2284
FORSTER A 100 72 2818
FORSTER D L 200 75 2595
300 75 2936
100 75 3397
FORSYTH R J 100 65 0344
FOSGATE O T 100 72 1553
FOSNAUGH J 300 69 0467
FOSTER J M 100 76 3239
FOWLER J C 400 74 1861
FOX J D 600 72 1076
100 73 1564
600 72 1709
FRAIPONT D R 300 72 2213
FRANCIS D W 100 74 3127
FRANGOS T G 200 69 0533
FRANK J F 200 73 2433
FRANK P A 500 70 0397
FRANKL G 600 74 1748
300 72 3026
FRANTSI C 100 71 0742
FRANZ M 100 71 1433
400 71 1479
FRASER C 100 73 1088
FRAZER E D 100 73 2354
FREAR D E H 200 69 0170
200 69 0196
FRECKS G A 600 73 1075
FREDERICK L R 500 70 0400
600 73 1065
FREEMAN L R 300 70 0488
FREEMAN M 300 75 3322
FRERE M H 100 72 1519
300 75 2880
FREY A L 600 72 1163
600 73 2928
FRIAR D E H 100 70 0413
FRICK G E 300 74 2042
FRIEDMAN S 300 71 1081
FRIES G F 100 76 3372
FRINK C R 200 70 0222
100 71 0453
300 70 0592
400 70 1176
200 70 2393
FRITSCHI E W 100 71 1232
FROBISH L T 300 71 0513
FROST D V 100 60 1078
FROSTER A G 100 71 2989
FRUS J D 100 71 0576
700 69 1650
600 69 2216
FRY L J 400 61 2360
FRYREAR J I 200 72 1152
FU Y C 300 71 1081
100 74 2047
FUJITA T 100 71 0303
FULHAGE C 300 75 3027
FULHAGE C D 700 73 2532
200 75 2718

# AUTHOR INDEX

FULHAGE C D 600 75 2902
200 75 2909
FULLER H L 400 60 1596
FULLER W H 300 71 1882
100 75 3260
FUNG D Y C 100 70 0026
FUNK J W 200 66 0120
100 66 0506
FWPC 300 70 0384
200 69 0539
GADDY J L 100 74 2263
GAIRC J V 600 73 1594
GAJMERAC W L 400 72 1438
GALBRAITH H 100 71 0468
GALEGAR W C 200 72 3455
GALLER W S 200 71 0805
300 71 1865
GAMBRELL R P 300 74 3047
GAR FORSHT R 300 74 2177
GARAJ O 500 75 3249
GARDNER F A 400 73 1492
GARMAN W H 400 73 1063
200 70 2506
100 73 2969
GARNER B 200 73 1648
GARNER G 300 64 1786
GARNER G B 300 71 0590
200 75 2739
GARNER W 200 72 1275
300 73 1622
GARRETT M K 100 76 3189
GARRETT W N 200 73 1062
GARRIGUS U S 100 71 0574
100 71 1047
GARSTANG J R 100 75 3474
GARTCN J E 200 71 0733
200 71 0779
300 71 1257
600 72 1262
200 72 1295
100 73 1339
600 72 1575
600 72 1992
GARTUNG J L 200 75 2709
GASSER W 100 71 1213
GAST R G 300 73 1787
GATES C D 100 63 0289
GEHLBACH A E 200 72 1285
GEHLBACH G D 200 73 2443
200 75 2628
GEHRT A J 100 72 1222
GEHRT K M 100 71 1213
GELDREICH E 100 70 1217
GELDREICH E E 100 62 0382
100 71 0484
100 66 1344
600 72 1753
GELMAN A L 100 71 2402
GENETELLI E J 200 69 0163
200 71 0832
GENTRY J B 300 71 1126
GENTRY R F 100 70 0025
200 69 0196
100 70 0413
100 73 2259
GEORGE B 400 76 3019
400 76 3138
GEORGE J A 700 70 2229
GEORGE P R 200 75 2632
GEORGE R 300 75 3148
GEORGE R M 300 71 0590
200 73 1330
600 73 1445
600 73 1463
600 73 1892
200 73 2483
600 74 3337
GERGEN B 400 74 2102
GERLOW A 300 75 2284
GERRISH J B 200 74 2004
200 74 2138
200 74 2151
100 74 2449
200 75 2605
200 75 2646
200 75 2721
300 74 2956
300 75 3051
100 74 3144
600 75 3202
100 75 3206
600 76 3342
100 74 3464
GERRY R W 100 68 0502
GERSHON S I 200 75 2623
GERSTNER J 400 70 1132
GEYER R E 200 71 0764
GIBBONS J 100 68 0077
GIBBONS J W 300 71 1126
GIBLIN P M 200 75 2601
GIBSON E A 400 67 0336
400 66 0354
100 66 3520
GIDDENS J 300 73 1367
100 75 2882
300 75 3398
GIHAD E A 100 76 3165
GILBERT B N 100 72 1215
GILBERT T R 100 73 1832
GILBERTSON C B 300 70 0010
100 71 0318
100 71 0573
200 71 0703
200 71 0776
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200 72 1023
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200 72 1282
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600 74 1684
100 74 1956
200 71 1978
200 74 2019
300 71 2076
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200 69 2221
300 74 2331
200 73 2475
200 75 2709
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300 69 2797
300 75 2863
200 74 3382
200 74 3388
200 74 3393
GILL D 400 72 1804
GILLESPIE H C 600 75 2862
GILLETTE A K 200 73 1333
GILLEY J R 400 75 2346
GILLHAM R W 100 69 0052
100 68 0452
GILLIAM J W 200 75 2758
300 74 3047
GILLILAND J 400 70 0022
GIRRES F 400 76 3147
GITAY H 100 71 0307
GIVENS R L 600 72 1074
300 73 1597
300 74 1602
GLERUM J C 200 70 0247
200 71 0859
GLOCK R D 100 75 2365
200 75 2684
GLOYNA E 300 70 1101
GOAN H C 300 70 0212
400 73 1313
GODDARD W B 300 74 1602
GODIN P 100 68 0296
GODZ P 300 75 3053
GOEPPNER J 100 74 2207
GOERING E 600 71 0271
600 71 0495
GOERING E H 600 72 1177
600 74 1888
GOERING H K 200 69 0169
100 70 0342
200 71 0851
GOETHE R W 200 75 2611
GOFF O E 100 73 1086
GOJMERAC W L 400 74 1810
200 71 1973
400 71 2083
600 72 3212
GOLD B 200 71 0659
GOLD R C 600 73 1609
GOLDBERG M C 500 70 0392
GOLDHAFT T M 100 69 0707
GOLDSTEIN J 400 73 1481
100 74 2337
100 75 2842
GOLUEKE C G 300 70 0668
100 72 0746
100 72 1430
200 69 1760
100 72 2197
GOMEZ M 300 71 0628
GOOD D 200 74 2000
300 73 2516
GOOD D L 300 73 1501
GOOD L D 700 71 1490
GOODRICH P R 200 71 0854
700 70 1256
GOODRICH P R 600 74 1543
300 73 1787
600 74 1952
300 73 2355
600 74 2356
600 73 2557
200 75 2586
200 75 2612
200 75 2619
200 75 2622
200 75 2756
300 74 3102
300 74 3104
300 73 3255
200 74 3363
200 74 3364
300 73 3498
GOODRICH R D 400 73 1373
600 73 1616
300 74 2217
300 72 2367
300 72 2368
300 72 2369
300 72 2370
300 72 2371
300 72 2372
300 72 2373
300 72 2374
200 75 2643
GOODRICH T D 100 71 1212
GOODSHIP G 100 73 1828
GORDON C H 200 69 0169
100 70 0342
200 71 0851
100 70 1090
100 71 1092
100 70 1823
GORDON H P 200 70 0687
GORDON V L 100 70 0270
GORDY J F 100 68 0036
GORMEL B 300 69 0631
300 69 0638
300 71 0674
300 71 0675
GOSCH J W 300 70 1059
GOTTBRATH J 600 73 1605
GOULDEN C E 100 64 1200
GOWAN D 200 70 0236
100 71 1214
500 72 1539
GOWDY B R 200 71 0600
GOYAL S M 100 70 0024
GRABBE K 200 75 2730
GRABER R 300 74 1889
GRAETZ C 200 75 3203
GRAHAM D B 200 72 1268
GRAINGER J M 100 73 2579
GRAMMS L C 100 71 0261
GRANT D W 200 69 0195
100 71 0273
200 71 0809
100 71 1423
200 74 1988
100 71 2570
200 75 2681
GRANT F 300 74 2044
GRANT F A 200 75 2728
GRANT K E 200 71 0282
GRASS L E 600 69 1239
GRAU C R 100 57 1507
GRAVES C 600 68 1862
GRAVES C B 200 69 0166
GRAVES R 400 74 1781
GRAVES R E 200 71 0858
400 74 1460
700 71 1689
600 72 1993
300 74 2100
400 75 2214
200 73 2478
200 75 2615
200 75 2699
600 75 2894
300 72 3076
300 72 3087
400 76 3282
GRAVES W 400 72 2210
GRAY M W 200 69 0426
200 69 0555
300 67 0701
GREEN K M 300 74 1860
GREENE J C 100 75 3141
GREENE L M 100 68 0036
GREENKORN R A 100 73 1793
GREER N I 100 73 3035
GREGORY K E 200 72 1028
GREIG J 200 74 2465
GRIBBLE D J 600 67 2178
400 76 3501
GRIEL L C JR 100 69 2808

# AUTHOR INDEX

GRIFFIN G F 200 75 2754
GRIFFIN H I 200 75 3370
GRIFFIN H L 200 72 1354
100 74 2932
GRIFFIN W L 200 68 0434
200 68 0726
GRIFFITH C C 100 70 0585
GRIMM A 200 72 1276
GRIMM K 200 71 0800
GRIMM V K 100 70 2822
GROSS C 400 71 1569
400 75 2107
GROSS S 400 76 3156
GROSSMANN E D 200 71 0813
GROUT A R 400 74 2114
400 74 2417
GROVES W 400 72 2231
GRUB W 100 69 0071
200 69 0165
200 69 0183
200 70 0232
600 70 0254
600 70 0255
600 70 0258
100 63 0436
300 71 0538
300 69 1180
200 72 1296
300 71 1739
300 1792
200 71 1927
GRUNCMAN J E 400 65 1141
GUEST R W 200 71 0662
200 73 1327
600 72 3502
GUGGCLZ J 100 71 0569
GULMAGE C 400 76 3138
GUMERMAN R C 200 69 0191
200 66 0587
GUNKEL W W 200 75 2915
600 74 3240
GUNTHER R W 300 74 2556
400 75 3343
GUPTA S P 100 73 1793
GURNHAM & ASSOC INC 200 73 3100
GUTHRIE R K 100 71 0722
GUTIERREZ J 200 64 1241
HABEEB W R 300 49 1210
HADDER A V 200 66 0144
HAEFELE E T 200 71 0285
HAFEZ A A R 100 74 2222
100 75 2272
HAGFELDT G 700 71 3096
HAGSTEN I 100 75 3360
HAHN L 200 73 1325
HAIDER K 100 72 1540
HAITH D A 200 74 2009
100 76 3275
HALBEISEN J 200 75 2662
HALBEISEN J L 300 76 3403
HALBROOK E R 100 61 2505
HALDERSON J L 600 73 1711
300 71 2062
HALE E B 200 71 0842
HALE W F 200 66 0123
HALEN F 600 75 3214
HALIBURTON J D 200 76 3402
HALL C F 300 73 1522
HALL D 200 75 2617
HALL D T 200 75 2741
HALL F 300 74 2956
HALL F E 200 69 0530
HALL M D 600 69 2175
HALL T H 100 74 1493
HALL W K 400 72 3296
HALLIGAN J E 200 73 1559
300 74 1900
200 72 2168
200 74 2185
200 73 2950
300 76 3157
HALLOCK D L 200 75 2675
300 75 3357
HALLOCK K L 300 74 2528
HALVORSON A D 100 75 3276
HALVORSON D 400 74 2041
HALVORSON H D 100 65 0263
HAMILTIN H E 200 75 2617
HAMILTON H E 200 71 0797
100 73 1034
600 72 1076
200 71 1096
600 71 1554
100 73 1364
600 74 1687
600 72 1709
700 71 1864
600 72 2073
100 74 2097
100 73 2134
HAMILTON H E 400 72 2415
100 76 3291
100 76 3292
100 75 3449
HAMILTON P B 100 74 1525
300 73 1849
HAMILTON W A 300 71 0745
HAMM D 200 70 0718
HAMMOND C W 100 68 0442
HAMMOND E G 200 71 0790
200 74 3368
HAMMOND W C 700 64 1735
600 66 2194
HANEKAMP W J 300 73 1733
HANES N B 100 72 2110
HANKE H E 400 73 1373
600 73 1616
300 72 2367
HANNAH H W 400 70 0068
HANSEN C M 100 58 0580
200 71 0827
200 72 1297
300 74 2388
HANSEN E H 200 71 0593
HANSEN E L 100 69 0353
100 68 0442
100 65 1573
600 66 2194
HANSEN R 200 74 1990
300 71 2523
HANSEN R W 200 69 0182
200 69 0430
300 71 0700
200 75 2687
600 73 2928
300 76 3286
HANSON A E 300 73 3498
HANSON L D 500 70 0394
HANSON L E 300 73 2355
600 74 2356
HAREIN P K 100 70 0018
HARGROVE T 400 71 1641
HARKER J H 100 74 2775
400 73 3099
HARKNESS R E 100 69 0035
HARL N E 300 71 1056
600 71 1728
HARLIN C C JR 100 70 0299
300 71 1245
HARMESON R H 200 71 1252
HARMON B G 100 69 0361
200 72 1089
100 73 1437
100 72 1675
200 72 1795
200 74 2021
200 73 2278
100 73 2342
200 73 2529
200 75 2640
200 75 2644
300 72 2983
200 74 3497
HARMON B W 200 71 0847
100 74 1950
100 75 2419
200 75 2652
HARMS L L 100 75 3112
HARMS R H 100 73 1495
100 75 3048
HARPER J M 200 75 2590
200 75 2687
HARPER J P 300 71 1238
100 74 2449
100 74 3144
100 74 3464
HARPER L 400 71 1544
200 69 2488
HARRINGTON R B 600 72 2074
100 74 2541
HARRIS G C JR 200 72 1441
300 73 1620
HARRIS J R JR 600 76 3305
HARRIS P 300 70 1248
HARRIS R L 100 73 2354
100 75 3201
HARRISON B T 200 75 2722
HARROLD L L 200 71 0774
100 70 1195
HARROLD T 400 71 0329
HARRY E G 100 73 1828
100 75 3460
HART S A 100 60 0059
200 66 0123
100 63 0338
100 65 0346
100 64 0371
600 68 0471
100 70 0684
200 70 1114
HART S A 500 68 1239
200 63 2155
200 64 2565
200 75 2623
100 75 3142
HARTER D A 400 73 1489
400 74 1769
300 73 3152
HARTER R D 200 70 2398
HARTMAN C 400 74 1781
HARTMAN G P 100 75 3276
HARTMAN R C 400 71 0297
400 70 0308
400 71 0315
400 75 2892
HARTUNG L D 200 71 0790
HARVEY C 200 74 2149
HARVEY T L 100 60 1677
HARWOOD D G 300 73 1517
600 73 1594
HASHIMOTO A G 300 69 0631
300 69 0635
200 71 0794
200 72 1311
100 71 1904
100 74 1912
200 74 2006
200 75 2736
600 75 2861
600 75 2878
200 74 3396
100 76 3445
100 76 3485
100 76 3491
600 75 3507
600 75 3517
HASSAN A E 200 75 2656
200 75 2908
600 75 3016
HASSAN H M 200 75 2658
200 75 2908
100 73 3299
HASSELMANN D E 100 74 2207
HAUSER V L 200 75 2710
HAWAII UNIV 200 71 1451
HAYAKAWA I 600 64 2204
HAYS V W 100 74 2097
HAZEN K R 400 74 1772
HAZEN T E 100 69 0095
100 69 0096
100 70 0102
100 69 0105
200 70 0248
100 66 0437
100 64 0474
100 71 0576
100 71 0582
200 71 0740
200 71 0803
200 71 0855
600 73 1065
600 72 1071
200 72 1281
200 72 1284
200 73 1526
200 74 2020
600 67 2205
600 69 2216
200 73 2436
100 65 2450
100 63 2549
100 63 2581
200 75 2738
300 73 2993
100 75 3017
300 73 3121
HEALD W R 200 71 0660
HEATH G E 100 75 3001
HEATH M S JR 200 71 0601
HEATHCOTE R G 100 70 0048
HECKER J F 100 73 1155
HEDGES J D 300 71 1672
200 75 2649
300 75 3356
300 75 3358
300 74 3495
HEFNER J J 600 72 1169
HEGG R O 600 70 0098
200 71 0780
200 72 1309
600 73 1364
200 74 2022
200 74 2024
300 72 2368
300 72 2373
200 75 2643
200 75 2732
HEIDAR F A 300 71 1238
HEIN M E 600 75 2836
HELLICKSON M A 100 70 0691

# AUTHOR INDEX

| | |
|---|---|
| HELLICKSON M A | 100 73 1381 |
| | 100 74 1894 |
| | 100 72 1960 |
| | 600 76 3258 |
| HELLMAN L | 100 71 0312 |
| HEMBRY F G | 100 74 1472 |
| HENDERSON H A | 300 73 2860 |
| HENDERSON H E | 300 71 0627 |
| | 200 71 0849 |
| HENDERSON J M | 100 62 0292 |
| HENDRICKSON D A | 100 71 1423 |
| HENNING A | 200 75 3183 |
| HENSLER R F | 100 70 0021 |
| | 100 71 0571 |
| | 200 71 0833 |
| | 700 68 2317 |
| | 100 70 2381 |
| | 300 75 2507 |
| HEPHERD R O | 100 71 2241 |
| | 200 75 2639 |
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# AUTHOR INDEX

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# AUTHOR INDEX

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LOCK J T 400 74 1861
LOEHR R 600 76 3167
LOEHR R C 100 69 0037
100 70 0050
200 66 0139
200 69 0157
200 69 0161
200 69 0184
100 67 0230
100 67 0233
100 69 0259
200 70 0324
100 70 0372
100 68 0500
200 71 0606
200 71 0642
200 71 0652
200 71 0653
200 71 0654
200 71 0660
200 70 0670
100 70 0684
200 71 0781
200 71 0821
200 70 1113
200 70 1115
200 68 1186
100 71 1228
100 68 1229
200 67 1243
200 72 1298
200 72 1311
100 72 1681
600 74 1686
300 74 1758
300 68 1776
300 73 1873
200 74 2009
200 74 2016
200 74 2026
600 72 2106
100 74 2109
500 74 2132
100 72 2190
200 71 2206
100 74 2223

# AUTHOR INDEX

LOEHR R C 100 72 2357
100 74 2525
200 75 2733
200 75 2735
100 70 2786
600 74 3240
300 74 3373
LOFGREEN G P 200 71 0777
600 72 1074
300 73 1597
300 76 3320
LOGAN E F 100 73 1790
LOGSDON G 100 75 2851
LOHNERT H J 200 75 3183
LONG F L 200 75 2751
100 75 2897
LONG T A 200 69 0170
200 69 0196
100 70 0413
200 71 1408
300 73 1856
200 70 2391
LONGHOUSE A D 100 70 0691
200 72 1279
200 70 2396
LOOKER M 400 73 3311
400 73 3535
LOOMIS E C 100 73 2169
LORENZEN R T 200 73 1327
LORIMOR J C 200 70 0216
200 70 0224
200 71 0775
100 72 1097
700 69 1690
600 73 1710
600 74 1744
100 73 2051
200 73 2481
200 75 2676
300 74 3123
LOUDON T L 200 74 2136
600 75 2559
200 75 2614
600 75 3202
400 76 3340
LOVELADY H G 100 70 0017
LOVETT J 100 71 0476
100 71 0572
LOWMAN R 100 69 0086
LOWMAN B G 100 70 2879
LOWREY R S 100 76 3504
LOWRY F E 100 75 2352
200 75 2751
100 75 2884
LOYACANO A F 600 72 1154
LOYNACHAN T E 200 74 2031
700 72 2569
LU J D 100 75 3125
LUBINUS L 300 74 2257
LUCAS D M 300 74 2526
100 75 2830
300 75 3352
LUCAS E 100 73 1464
LUCHTERHAND C K 200 71 1969
LUCK H W 300 75 3147
LUDINGTON D 600 75 3166
LUDINGTON D C 400 70 0091
200 66 0143
300 69 0631
300 69 0635
200 71 0642
200 71 0657
200 71 0661
300 71 0674
300 71 0675
200 71 0794
200 72 1311
200 64 1698
100 71 1904
200 63 2160
600 67 2198
600 75 2861
200 74 3385
200 74 3394
100 76 3487
LUEBS R E 100 73 1087
400 73 1957
100 74 2256
200 72 2995
200 71 3465
LUKE G W 200 70 0326
LUND A F 100 75 2352
LUND Z F 200 75 2751
100 75 2884
100 75 2897
LUNIN J 500 71 3515
LUSZCZ L J 100 74 2502
LUTHER R M 200 75 2662
LUTZ J F 300 1546
LUTZ R 400 72 2573

LYERLY P 300 75 3049
LYERLY P J 200 71 0828
600 72 1169
300 73 3118
LYLES L 400 74 3518
LYNN H P 200 73 1329
700 68 2318
LYONS D F 100 74 2784
MACARTHUR J 200 71 0813
MACDAID E 100 72 3032
MACDONALD F W 100 66 0473
100 71 1232
MACDONALD J A 100 74 3293
MACGREGOR J 300 73 2355
600 74 2356
MACGREGOR J M 300 74 3102
MACKENTHUN K M 200 71 0613
MACKENZIE A J 100 74 2131
MACKENZIE J D 200 75 2657
MACKEY D R 500 71 1255
MACKIEWICZ A 400 74 1765
MACKSON C J 200 66 0142
300 70 0206
MACMILLAN K 200 72 1303
MACMILLAN K A 100 75 2813
MACQUEEN A 100 75 3222
MADDEN J M 200 71 0773
300 73 1376
600 73 1589
600 71 2839
600 70 3410
MADDEX R L 200 74 2149
600 75 2559
200 75 2614
MADEWELL C E 200 75 2683
MAHAN R P 700 72 2315
MAHLOCH J L 100 74 2124
MAHONEY G W A 200 71 0733
200 68 0760
200 71 0779
200 72 1152
300 71 1257
600 72 1262
200 72 1295
100 73 1339
600 72 1575
600 67 1683
600 72 1992
MAJORS K R 600 71 1714
MALIK D D 200 66 0129
MALONEY T E 100 75 3141
MANAGEMENT GUIDE COM300 72 1157
MANCHESTER A C 200 72 1353
MANES J D 100 71 0464
MANGAT S 100 73 3315
MANGES H L 600 71 0271
600 71 0495
200 71 0778
600 72 1177
200 72 1301
600 74 1671
600 73 1813
600 74 1888
300 73 2043
300 73 2208
200 73 2486
100 75 2490
300 75 2494
200 75 2663
600 75 2871
100 75 2926
100 74 2958
100 75 2994
100 75 3401
100 75 3414
MANN A R 600 72 1071
MANN G S 100 73 3315
MANNEBECK H 200 74 2015
MANNERING J V 300 73 1640
600 74 1845
300 75 2874
MANTHEY E W 400 72 1138
400 73 1191
400 74 1636
400 74 2048
MARCH W R 300 72 3026
MARCOOT R E 400 76 3433
MARINI A C 200 75 2626
MARLAR J T 300 70 0491
MARRIOTT L F 200 71 0834
200 72 1299
200 75 2616
200 75 2673
MARSCHANG F 500 75 3244
MARTEN J F 300 75 2874
MARTENS D C 300 71 1672
300 74 2528
200 75 2675
600 75 3277
300 75 3357

MARTENS D C 300 75 3358
300 75 3359
300 74 3495
MARTIN G A 600 73 1594
MARTIN J D 600 70 0254
700 71 1688
MARTIN J E 300 75 3172
MARTIN J H 600 74 1686
MARTIN J H JR 200 72 1278
200 74 2026
200 75 2735
MARTIN J JR 600 76 3167
MARTIN K L 600 72 1560
MARTIN R D 100 70 0028
100 70 0082
200 70 0716
300 70 1388
MARTIN W J 100 71 0291
MARTIN W P 400 70 0070
500 70 0394
200 71 1966
MARTIN W W 300 76 3153
MARTINDALE L 100 75 3140
100 76 3521
MARTINEZ J 700 73 2972
MASSIE J R JR 200 73 1083
MASSIE L R 200 71 1972
200 75 2699
MASTERS G C 400 76 3106
MATEUZZI D 100 74 2923
MATHER J M 200 75 2722
MATHERS A C 200 70 0223
200 71 0826
300 1077
300 70 1447
200 73 1510
300 72 1561
100 74 2064
200 75 2660
300 75 3219
MATSON W E 300 71 0704
MATSUSHIMA J K 200 74 1989
300 74 2173
MATTHEW F L 200 69 0563
MATTHEWS P R J 100 76 3466
MATTHEWS S 600 76 3138
MATTHYSSE J G 100 70 2520
MATTINGLY G E G 100 73 2521
MAUGH T H II 100 72 2314
MAY J D 100 73 2431
MAYES H F 600 71 0497
300 73 1468
600 73 2574
MAYES J L 200 69 0546
200 64 0759
MAYLAND H F 100 75 3524
MAYROSE V B 100 71 0683
200 74 2032
MAZURAK A P 600 71 0100
100 74 2130
100 74 2515
100 75 2891
600 75 3199
100 76 3265
MC WHORTER J C 600 71 0288
MCALLISTER J S V 100 70 0578
200 75 3182
100 75 3225
200 73 3308
100 70 3339
MCAUSLAN J T 300 73 3408
MCCABE T 200 75 2617
MCCAIN F 200 75 2640
MCCALLA T M 300 70 0010
200 70 0216
100 71 0318
500 70 0400
100 71 0573
200 71 0583
200 69 0676
200 71 0775
200 71 0776
200 71 0798
200 72 1020
500 71 1072
100 72 1129
200 72 1282
100 71 1312
300 72 1314
200 73 1415
100 72 1530
100 74 1535
100 72 1536
300 72 1628
600 74 1684
100 74 1956
400 74 2070
600 73 2124
100 75 2250
300 72 2260

# AUTHOR INDEX

MCCALLA T M 400 72 2320
300 74 2331
100 73 2447
300 75 2837
500 75 2863
200 74 3365
200 74 3388
100 76 3450
MCCAMPBELL H C 100 76 3504
MCCARTNEY H G 100 68 0011
100 71 0460
MCCASKEY T A 200 71 0829
300 73 1366
200 75 2654
MCCLEAN G R 300 72 2213
MCCLUNG J 400 76 3440
MCCLURE K E 100 73 1637
MCCLURE W H 200 66 0145
300 74 2934
300 75 3354
MCCLURG C A 300 71 0412
MCCORMICK W C 100 75 3064
MCCOY E 200 66 0116
100 65 0334
200 69 0482
200 69 0518
300 68 1122
600 69 2179
MCCRCSKEY J E 200 71 0705
600 72 1153
MCCURDY J A 200 75 2693
MCEACHRON L W 200 69 0201
MCELROY A D 200 72 1275
600 74 1568
200 74 1997
300 76 3042
MCELROY B 400 73 2504
MCEVER L F 600 74 2081
MCGHEE T 200 72 1054
MCGHEE T J 100 72 1235
100 73 1391
100 73 1558
600 73 1754
100 76 3421
MCGILL H N 200 71 1929
200 75 2609
MCGINNIS J 100 73 1464
MCGRIFF E C 100 73 1833
MCGRIFF E C JR 100 74 2126
MCGUFFEY K 100 72 1529
MCGUINNESS J L 200 75 2706
MCHENRY S 100 61 2534
MCILWAIN R 200 71 0835
MCINTOSH J I 100 72 1480
MCINTOSH J L 100 72 1600
100 73 2962
MCKEE G W 300 76 3004
MCKEEN W D 300 75 2545
MCKELL C M 100 70 0340
MCKELVIE A D 200 75 2667
MCKENNA J R 300 73 2865
MCKENNA M F 200 70 0220
MCKIE B 100 70 0110
MCKINNEY R E 500 70 0401
200 70 0728
300 67 1253
MCLAREN J B 300 73 2096
300 73 2903
300 75 3172
100 76 3300
MCLENDON B D 600 75 2862
100 76 3504
MCMANUS J A 100 69 1042
MCMUNN E W 200 71 0619
MCNAB J M 100 74 3527
MCNABB C G 200 69 0562
300 71 0590
300 69 2078
MCNABB F M A 100 75 3426
MCNABB J 300 72 1085
MCNABB R A 100 75 3426
MCNIVEN M 100 75 3477
MCNULTY D E 300 74 2576
MCNULTY D E O 500 75 3451
MCQUIGG J D 200 73 1325
MCQUITTY J B 300 72 1425
100 71 2200
300 74 2940
MCROBERTS F 600 69 2175
MCWHORTER D B 600 75 2492
200 75 2755
MCWHORTER J C 200 72 1908
MEADE T L 400 73 1181
MEADOR N F 600 75 2902
MEARS D R 200 75 2620
200 75 2920
MEEK A M 200 69 0188
MEEK B D 600 69 1239
100 74 2131
MEENAGHAN G F 200 70 0232
MEENAGHAN G F 600 70 0255
600 70 0258
300 71 0538
300 69 1180
200 72 1296
300 71 1739
200 72 2174
MEHTA B S 200 75 2747
MEHTA P C 100 72 3461
MEIERHOFER G S 200 75 2619
MEIMAN J R 300 68 2220
MEINHARDT P 400 71 2275
MEISKE J C 400 73 1373
600 73 1616
200 74 2022
300 74 2217
300 72 2367
300 72 2368
300 72 2369
300 72 2370
300 72 2371
300 72 2372
300 72 2373
300 72 2374
200 75 2643
MELSTED S W 200 71 0669
MELVIN S W 600 73 1710
600 71 1715
600 71 1721
600 74 1744
100 75 2410
200 73 2481
200 75 2676
300 74 3123
MENDEL V E 100 70 0014
200 66 0125
MENEAR J R 200 73 1093
100 73 1773
MENSCH R L 600 71 2778
MENZIE E L 300 73 1733
MERCER R 400 74 3101
MERKEL J A 100 69 0096
700 68 1826
MERRILL R 300 73 3330
MERRILL W G 200 69 0188
MERRILL Y 300 73 3330
MERVA G E 100 75 3206
MESSER J W 100 71 0476
100 71 0572
METLIN S J 100 74 2047
METZLER D F 300 75 2982
MEYER D F 200 75 2625
MEYER D J 200 75 2634
MEYER J L 300 74 1601
300 1767
200 74 2033
300 72 2292
200 72 2996
300 3024
300 75 3263
MEYER R C 200 71 0812
MEYER V M 200 73 2476
MICH ST UNIV 200 74 2135
MICH STATE UNIV 300 76 3169
MICHIGAN STATE UNIV 300 71 2421
MIDDAUGH P 100 75 3112
MIDDAUGH P R 200 71 0796
200 70 1053
300 75 3075
200 74 3392
MIDDEN T M 200 71 0860
600 72 2073
100 73 2134
700 72 2401
700 72 2770
MIDDLEBROOKS E J 100 75 2931
MIDDLEBROOKS J E 100 74 2408
MIDWEST PLAN SERV 300 72 1470
300 73 1835
MIDWEST RES INST 300 71 0677
MIELKE L N 200 70 0216
200 70 0224
200 71 0775
100 72 1097
100 73 1382
100 72 1530
100 74 1535
600 74 1846
100 73 2051
100 75 2280
100 73 2447
700 74 2564
200 75 2608
200 75 2661
600 75 3199
100 76 3257
100 76 3265
200 75 3270
MILBERGER W 600 73 1521
MILLER A L 200 73 1189
MILLER B F 200 69 0173
400 69 0419
300 71 0477
100 71 1588
100 73 1747
100 73 1801
400 69 1924
100 74 2189
300 73 2954
MILLER D W 300 75 2339
MILLER E C 200 74 2150
600 73 2557
300 73 3498
MILLER G D 600 73 1384
300 75 3172
100 76 3300
MILLER J A 100 75 3201
MILLER K P 300 72 2370
MILLER M H 400 73 1073
MILLER R A 700 74 2405
200 75 2596
100 76 3443
MILLER R D 300 70 1084
200 72 1359
MILLER R F 300 75 3482
MILLER R W 300 71 0515
100 70 1090
100 71 1092
100 70 1823
100 73 2325
100 75 2881
MILLER T 200 75 2745
MILLER W D 300 71 0269
300 71 0466
200 71 1931
100 71 2413
MILLER W E 100 75 3141
MILLER W J 400 76 2933
MILLS K C 100 69 0108
MILNE C 300 74 2555
MILNE C M 600 74 2068
600 70 2530
600 71 2531
MILNE R A 100 73 1444
MINCHINTON I R 100 73 3324
MINER J R 100 70 0049
100 69 0096
100 70 0102
100 67 0104
100 69 0105
200 66 0120
100 70 0228
200 70 0248
600 71 0272
100 67 0302
500 70 0399
100 71 0447
200 71 0483
300 71 0486
600 71 0496
100 66 0506
200 69 0549
100 71 0576
200 67 0734
200 70 0737
200 64 0759
200 71 0788
200 71 0790
200 71 0803
200 71 0808
200 71 0855
600 72 1071
200 66 1112
100 70 1227
200 72 1281
200 72 1284
200 72 1287
200 73 1320
600 71 1716
600 71 1720
700 67 1838
300 73 1851
100 74 1855
300 73 1881
300 74 1959
100 74 2209
600 69 2216
300 74 2248
300 74 2382
600 75 2537
200 64 2567
200 75 2631
200 75 2689
200 75 2697
200 75 2717
300 75 2824
300 74 2833
200 75 2919
200 75 2952
300 73 2993

# AUTHOR INDEX

MINER J R 600 75 3015
300 75 3028
300 73 3121
300 75 3149
600 76 3254
200 74 3390
200 74 3394
200 76 3468
100 76 3509
MINSHALL N E 100 70 0042
100 69 0061
200 69 0482
600 69 2179
MIS RIVER TASK GROUP 300 71 2196
MITCHELL J K 200 73 2437
100 76 3289
400 75 3343
MITCHELL W H 200 74 2461
MITKEES A I 100 73 3299
MITTEE 300 72 1157
MIYAHARA A Y 100 71 0461
MIYAZAKI S 100 71 1223
MOAWAD S K 100 70 1040
MOELLERS K C 300 74 2452
MOHSENIN N N 600 70 0080
MOLDENHAUER W C 500 70 0387
MOLINA J A E 300 70 0475
MONKE E J 200 71 0854
MOODY W B 200 71 1930
MOORE C R 300 73 2039
MOORE III S 200 73 2439
MOORE J A 600 70 0098
200 66 0123
200 66 0128
200 69 0178
500 70 0403
600 68 0471
100 70 0678
200 69 0706
200 71 0823
200 69 1116
600 73 1364
600 71 1722
200 74 2024
300 72 2368
300 72 2373
200 74 2470
200 73 2482
200 75 2643
600 74 3337
200 74 3389
200 74 3395
300 75 3454
MOORE J C 100 70 0418
MOORE J O 200 74 2022
MOORE W E 200 71 0847
MOORMAN R JR 100 65 0470
MORA-MINZAT R 500 75 3244
MORGAN N O 100 70 0028
100 70 0082
200 70 0716
200 71 0852
100 70 1090
300 70 1388
600 72 1752
100 70 1823
MORRIS G L 200 66 0117
MORRIS G R 200 75 2910
600 74 3240
MORRIS T B JR 600 73 1594
MORRIS W H M 200 66 0152
200 71 0816
300 1829
MORRISON J L 100 69 0081
MORRISON S M 200 69 0195
100 71 0273
200 71 0809
100 67 1258
600 72 1560
200 74 1988
200 75 2681
MORRISON S R 100 70 0014
200 66 0125
200 71 0777
600 72 1074
300 73 1597
300 74 3122
MOSIER A R 100 74 1400
100 72 1540
100 73 2249
MOTE C R 200 75 2707
200 75 2720
200 73 3399
MOUM S G 100 69 0707
MUCK R E 600 75 2861
MUEHLING A J 300 69 0001
300 69 0002
300 69 0003
300 69 0004
300 69 0005
MUEHLING A J 300 69 0006
300 69 0007
200 71 0607
100 70 0685
300 70 1000
200 70 1159
600 71 1737
600 72 2122
300 74 2428
200 73 2474
500 71 2524
200 75 2628
MUGIWRA L M 100 76 2957
MUHAMMAD A 300 74 2042
MUIR F V 300 72 1603
MUIR J 100 73 1446
100 73 1663
MULKEY L A 600 72 1001
200 75 2677
MULLIGAN T J 200 72 1306
MULLINS J A 200 75 2670
MUNTER R C 600 74 2356
300 74 3102
300 74 3104
MURPHY D W 100 74 3288
MURPHY J P 600 75 2901
MURPHY L S 100 71 0681
300 65 0739
200 71 0778
300 70 1059
600 72 1177
200 72 1301
300 74 1783
300 73 2043
100 73 2113
300 73 2208
200 73 2486
100 75 2490
300 75 2494
300 75 2495
200 75 2663
200 75 2748
100 75 2926
100 74 2958
100 75 2994
100 75 3069
100 75 3401
MURRAY I 100 75 3221
MURTHY G K 100 71 0572
MUSGRAVE R B 200 69 0201
MUTLAK S M 200 75 2667
MYERS E A 200 66 0124
200 74 1527
N 200 74 2463
N J TASK FORCE 200 70 0320
NABBEN M 600 72 1151
NAKAHARA J 200 71 1453
NARAYAN R S 100 72 1188
700 71 2309
NASH W J 100 71 2760
100 71 2761
NATH J 100 73 3470
NATH K R 100 73 1402
NATL FEED INGRED ASS 200 74 2463
NATWICK H A 200 75 2612
NATZ D 400 71 0686
400 72 2273
NEAR C R 200 75 2702
NEATHERY M W 400 76 2933
NEB DEPT ENV CONTROL 200 73 1420
NEB UNIV 200 63 2153
NEBGEN J W 300 76 3042
NEBRASKA UNIV 200 64 1691
NEFF M 300 71 0628
NEGM M A 100 73 3299
NEGULESCU C A L 200 75 2638
NEILSON D R 200 74 2033
NELL J A G 100 71 2760
100 71 2761
NELSON D 200 71 1456
NELSON D C 300 2571
NELSON D K 100 70 1211
NELSON D L 300 73 3152
NELSON D W 200 74 2032
NELSON G L 200 69 0166
600 67 1683
600 66 1743
600 68 1862
NELSON G S 200 72 1441
300 73 1620
NESHEIM M C 200 72 1290
NEVINS M P 200 69 0195
100 71 0273
100 71 2570
NEWCASTLE UPON TYNE 200 70 0234
NEWMAN G 200 75 2618
NEWTON D F 100 70 2763
NEWTON G L 600 75 3214
NEYELOFF S 200 75 2915
NGODDY P O 300 71 1238
NGODDY P O 100 74 2449
100 74 3144
100 74 3464
NICHOLS M S 100 70 0042
100 69 0061
200 66 0116
100 65 1219
NICHOLSON H P 500 70 0396
NIELSEN D B 400 72 2283
NIELSEN D R 300 1767
NIENABER J A 200 72 1015
100 72 1129
200 73 1413
100 73 1424
600 74 1684
100 74 1956
200 74 2019
600 73 2124
300 74 2331
200 73 2475
200 75 2709
300 75 2863
NIESWAND S P 600 74 1686
NIGHTINGALE H I 100 70 1041
100 72 2187
NILES C F 200 70 0687
NILES C F JR 200 68 1642
NIPPER W A 600 72 1154
NIX R 100 62 2535
NIXON C C 600 75 2871
NODWELL J H 200 69 0175
200 68 0724
NORDSTECT R 700 69 1067
NORDSTEDT R A 200 71 0769
200 71 0782
200 71 0791
200 73 1328
200 75 2737
300 75 2852
600 76 3278
400 75 3347
100 75 3448
NOREN O 100 74 2430
NORSTADT F A 200 74 1987
300 75 2837
100 76 3014
200 75 3193
NORTHERN W L 200 73 1329
NORTON T E 200 69 0182
200 69 0430
600 69 1160
NOVCSAD A C 300 75 2284
NUNLEY J W 100 76 3186
NURNBERGER F V 200 66 0142
NYE J C 100 71 0588
200 73 1317
300 73 1640
600 73 1844
200 74 2032
600 72 2074
200 73 2480
100 74 2541
200 75 2603
200 75 2621
700 71 2978
600 75 3018
300 75 3148
300 74 3319
300 76 3519
NYE J T 200 75 2636
O BRIEN T 200 69 0547
O CALLAGHAN J R 100 71 0688
100 73 2582
200 75 2668
200 75 2734
100 71 2782
100 74 2784
100 74 3529
O DELL R A 200 69 0180
O DONOGHUE P A J 100 71 0688
OATWAY E T 200 75 2704
OCONNELL D 100 75 3458
ODELL B L 100 60 2518
ODELL R T 200 75 2602
ODOM J N 300 75 3172
300 75 3176
OGILVIE J R 200 69 0176
200 71 0841
600 73 1394
300 71 2062
200 75 2716
100 74 3431
100 76 3441
OGLESBY R T 200 71 0646
OGLESBY W C 100 64 0343
OHNMACHT CH 100 72 1667
OKEY R W 200 69 0199
200 70 0219
200 71 0818
OLDFIELD J E 200 75 2631

# AUTHOR INDEX

OLDFIELD J E 200 75 2919
OLECHOWSKI G C 100 69 0736
OLIPHANT J M 100 74 3007
OLIVER J C 300 74 1601
400 71 1899
400 75 2547
300 73 2867
OLSEN R J 100 70 0021
200 69 0482
100 71 0571
300 69 1044
300 69 1124
600 69 2179
100 70 2381
OLSON E 300 72 2292
300 3024
OLSON E A 400 71 0298
300 71 0689
200 72 1018
200 73 1416
600 73 1504
300 74 1678
OLSON E H 300 72 2533
300 75 3263
OLSON P P 400 72 2283
OLSON R A 100 73 1446
100 73 1663
OLSON W A 300 72 1599
OLTJEN R R 100 76 3425
OLTON G S 100 75 2456
OMERNIK J M 300 76 3040
OMTVEDT I T 200 68 0760
ONEAL M V 700 73 2061
100 76 3421
ONEIL J B 100 75 3000
ONIANI O G 100 73 2521
ONSTAD C A 600 74 3271
OPPENLANDER J C 600 75 3074
ORG ECO CO-OP E DEVL 300 73 3325
ORMROD D J 100 73 1790
OROURKE W 400 72 1380
ORR D E 300 73 2053
ORR H L 100 71 0187
100 71 0266
ORTON W L 600 74 1567
OSBORNE L E 200 75 2639
100 75 3404
OSBURN D D 200 73 1325
OSCHWALD W R 300 71 1035
OSTERBERG C G 700 72 2127
OSTRANDER C 200 64 1699
OSTRANDER C E 200 66 0122
200 69 0185
400 71 0575
200 71 0651
200 71 1646
200 74 1867
200 63 2154
400 2191
200 75 2604
OSWALD W J 300 70 0668
100 72 0746
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OTTOSON H W 200 72 1029
OVERBY L R 100 60 1078
OVERCASH M 600 74 2050
300 74 2850
OVERCASH M R 600 74 1958
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200 75 2633
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100 76 3269
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200 74 3396
OVERMAN A R 200 70 0221
200 71 0856
OVERTON J R 300 75 3178
OWEN J R 300 75 3173
300 70 3314
OWENS J D 100 72 1224
100 73 1905
OWENS M 200 73 3307
OWENS T R 200 68 0434
200 68 0726
200 71 0820
300 1792
OWINGS W J 100 65 0066
300 61 2326
PAC NRTHWST LAB 300 69 2099
PACKER R A 100 69 0714
PAGE J W 100 74 2404
PAIN B F 100 74 3033
PAIN B F 100 74 3034
100 75 3072
PAINE M 400 73 1475
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300 72 1440
400 72 1804
300 72 2088
600 74 2119
300 72 3198
PALKO T N 300 74 2921
PALMER G L 500 70 0400
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PARA L 500 75 3249
PARK K L 100 74 2263
PARK W E 300 74 1891
PARKER B F 100 69 0108
PARKER G B 200 74 2005
200 73 2484
600 75 2885
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PARKER H W 200 73 1082
200 73 1083
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200 74 2185
200 73 2950
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200 74 3409
200 76 3475
PARKER J L 400 74 2493
PARKER R 600 74 2050
PARKER R L 600 74 1958
PARKHURST C R 100 74 1525
300 73 1849
PARKS B A 600 1584
PARSO A A 200 69 0173
PARSONS J L 100 69 0035
PARSONS J W 100 75 3221
PARSONS R A 400 70 0097
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PATE F M 200 74 2971
PATEL H B 200 74 1868
PATEL J D 100 67 0448
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200 74 1868
PATEL R E 400 71 1487
PATNI N K 200 72 1305
100 74 2108
200 72 2361
100 72 2412
PAULIN D M 400 74 3326
PAULSEN D J 100 67 2192
PAULSON G D 100 69 0690
PAULSON W H 100 71 0571
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PAULSON W L 300 69 0093
PAYNE C G 100 66 0479
PAYNE F A 600 72 1076
100 73 1564
PAYNE J I 200 70 0250
PEABODY F R 300 74 2388
PEACH D 400 73 1520
PEAKALL D B 100 70 1111
PEARCE G R 200 75 2650
PECK J H 100 70 0013
100 69 0373
100 69 0374
PECK T R 200 72 1399
PEDERSON R W 200 71 0643
PEELER J T 100 74 3127
PENDLETON R F 200 71 0650
PENN ST UNIV 200 74 2457
PENNY A 100 74 2340
PEO E R JR 200 74 3365
PERELMAN M 100 73 2176
PEREZ-ALEMAN S 100 71 3374
PERRY C A 400 68 0101
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PERRY T W [illegible] 72 2074
100 74 2541
100 75 3360
PERSON H L 600 71 0272
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200 72 1287
PETERS A J 200 75 2618
PETERS D C 500 70 0398
PETERS R E 200 73 1322
300 73 3118
100 76 3489
PETERSEN J 600 75 3166
PETERSON G A 100 73 1800
PETERSON J R 500 71 1072
PETERSON M 200 73 2487
PETERSON M R 300 71 0590
200 73 1330
400 74 2066
PETERSON N L 200 69 0557
200 69 0561
PETERSON R A 100 70 0691
PETERSON R L 300 76 3157
PETERSON S A 100 68 0306
PFANDER W H 300 64 1786
PFEFFER J T 200 71 0837
200 71 0861
600 73 1583
PFOST H B 300 71 0692
PHAR P A 100 71 0462
300 70 0743
PHELPS A 400 70 3312
PHERSON C L 200 74 2012
700 73 2772
PHILLIPS F W 400 70 3297
PHILLIPS G W 300 73 1733
PHILLIPS J A 600 73 1594
PHILLIPS P A 200 75 2716
100 74 3431
PHILLIPS R E 200 73 1330
400 74 2066
PHILLIPS R L 200 72 1310
600 76 3159
PHINNEY H K 300 74 1959
200 75 2631
200 75 2919
PHIPPS R H 100 74 3034
PIATT C 100 67 0302
PICKENS L G 100 71 1092
100 73 2325
PICKETT E E 200 75 2739
PIERCE R A 200 69 0188
PIERCE R L 200 71 0796
PILE R S 300 75 3177
PIMENTEL D 200 71 0645
PINCHIN J H 300 72 2213
PISKIN R 100 73 3361
PITTMAN D 300 70 1248
PITTMAN D L 200 71 1933
PITTMAN U J 100 73 1444
PLOTKA E D 100 70 0064
100 69 0693
PO C 200 75 2656
PUELMA H R 200 70 0247
200 70 0253
200 71 0859
POHL S H 600 76 3258
POINTER C G 200 70 0244
POLIN D 300 71 0628
300 75 3055
POLKOWSKI L B 200 66 0116
100 71 0261
200 71 0840
600 72 1004
300 68 1122
200 71 1547
100 74 2045
POLLOCK K A 100 71 0688
100 73 2582
200 75 2668
100 71 2782
POLSON A 100 71 0307
POMEROY B S 200 71 0836
100 73 1685
300 73 2384
200 74 3363
PONTIF J 600 72 1154
PONTIN R A 100 68 0381
POOLE W H 600 74 1608
POONIA S R 100 73 3459
POPE W H 100 72 2509
POPEL F 100 72 1667
PORCELLA D B 100 75 2931
PORGES R 200 64 1693
PORTER H C 200 71 0842
PORTER L K 300 75 2837
100 76 3014
PORTER R M 200 73 1335
PORTER W K 200 69 0523
POS J 100 71 0187
200 69 0187
100 71 0266
100 71 0729
200 71 0824
200 73 1334
100 71 1902
100 73 2779
100 71 2787
POWELL R 200 71 1968
POWELL R D 200 75 2699
POWER T 100 74 2988
POWERS W I 100 75 3401

# AUTHOR INDEX

POWERS W L 100 71 0681
200 72 1301
300 74 1783
300 73 2043
100 73 2113
300 73 2208
200 73 2486
100 75 2490
300 75 2494
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PRAKASAM T B 200 74 3395
PRAKASAM T B S 300 74 1758
200 74 2026
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100 72 2357
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200 74 3386
PRAKASAM T B X 300 73 1873
PRATT G L 100 69 0035
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600 71 1718
600 66 1743
600 74 1847
600 73 1852
700 67 1877
600 72 2262
100 71 2351
200 75 2701
PRATT M 100 75 3499
PRATT P F 100 71 0450
200 71 0830
400 71 1899
200 74 2034
100 74 2082
200 72 2997
PRATT P R 100 73 2121
PRATT T B 400 72 2224
PRAWIRCKUSUMO S 100 76 3301
PRES WATER POLL CONT300 72 1576
PREUSCHEN G 200 74 3366
PREWITT L R 200 74 2136
200 75 2614
PRICE D R 600 72 1031
600 74 3240
100 76 3487
PRICE F 400 70 0097
400 72 2298
PRICE F C 400 74 1827
PRICCP GH 200 75 2666
PRIEST R F 600 75 3506
PROCTOR D E 100 69 0030
200 68 0694
200 71 0784
200 68 1187
300 74 1527
300 74 2955
PROPHET C W 100 73 1449
200 67 3434
PRYOR W A 100 75 3456
PRYOR W J 100 70 0047
100 64 0072
PUNTAMKAR S S 100 72 3461
PURDUE UNIVERSITY 300 72 1503
PURDY R W 200 74 2141
PURUSHCTHAMAN C 100 74 3462
PUTNAM G S 600 75 3016
QUARLES C L 100 70 0025
300 1774
100 75 3003
QUICK A J 200 70 0249
QUISENBERRY J W 200 66 0129
400 69 1523
200 72 1645
RADEMACHER J M 200 69 0181
500 70 0410
200 69 0424
200 69 0542
RAFAI P 500 75 3241
RAGER K TH 100 72 2764
RAKES J M 300 74 1619
300 74 3151
RALL G D 100 70 0362
RANDALL G W 600 73 2557
200 75 2756
300 73 3498
RANGASWAMY P 100 73 2798
RANKIN J D 100 69 0416
RAO A M 300 73 1367
100 75 2882
700 73 2973
RAPP E D 100 74 2263
RASMUSSEN D 200 75 2702
RATH P H 700 66 1679
RAUSCHKOLB R S 300 3024
RAY M L 300 65 2558
400 76 3008
READ B JR 100 71 0476
REDDELL D L 200 71 0828
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600 72 1169
200 73 1322
200 74 1500
600 73 1614
200 73 1648
600 74 1751
600 74 1961
200 74 2029
600 73 2245
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300 75 3049
300 73 3118
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200 74 3396
100 76 3489
REECE F N 100 71 0695
100 73 2431
REED C H 200 66 0130
200 69 0172
200 70 0325
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200 75 2715
200 73 2966
REED M J 100 68 0011
600 75 2970
REEDER N 400 71 1918
REES B 100 71 2358
REICHERT K A 200 69 0175
REID J T 200 71 0846
300 65 2267
REID W S 200 71 0648
REIMAN K 400 71 1196
REKERS R G 100 71 1038
REMMELE P G 100 74 1894
700 73 2583
RENEKER R W 300 71 0744
RESNIK A V 200 69 0181
200 69 0424
200 69 0563
RETRUM R 200 70 0321
REY G 300 70 0492
REYNOLDS W L 100 74 1472
RHODES D N 100 71 2809
RHODES R A 100 72 1555
600 74 1567
100 72 1788
100 74 3025
100 74 3150
RIBLE J M 300 74 1601
200 75 2686
RICHARDSON G 400 72 1842
400 76 3228
RICHARDSON L 400 72 2795
RICHTER J 400 71 1137
400 76 3233
400 76 3378
RICKETTS RALPH 100 65 0378
RICKLES R N 200 69 0199
200 70 0219
RIDLEN S F 400 70 0113
RIECK R E 300 70 1839
RIEMANN U 200 72 1307
200 74 2028
100 73 2815
100 72 2817
RILEY C T 400 66 0088
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200 70 0235
200 70 0243
100 68 0337
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RIRIE D 300 76 3438
RITTER W F 200 75 2698
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RIXFORD C E 300 70 0668
ROBBINS J 700 70 1066
ROBBINS J W D 100 69 0060
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200 75 2743
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100 74 3030
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ROBSON C M 200 69 0167
ROBSON C M B 700 69 2181
RODRIGUEZ J G 100 70 0570
ROEHRIG S 200 71 1458
ROHLICH G A 500 70 0405
ROKEBY T R C 200 72 1441
ROLAND D A 100 75 3048
ROLL J L 600 73 1583
400 74 2336
700 73 3323
ROLLER W L 100 69 0316
ROLLINS G H 200 71 0829
300 73 1366
ROLLO C A 100 63 0436
ROMAN GH 200 75 2666
ROONEY W F 300 75 2545
ROPER W E 100 68 1579
ROSENAU R C 100 75 3524
ROSENFELD R S 100 71 0312
ROSCCHA J 500 75 3249
ROSS D S 200 75 2693
ROSS E 100 68 0043
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ROSS I J 100 69 0108
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ROSSON H F 300 74 2922
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ROTH L J 600 72 1954
ROUSTON R C 100 69 1659
ROZICH F J 200 69 0545
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RUDESTEDT J 400 72 3139
RUEHR T A 200 74 1991
RUF J A 100 68 1229
RUMBURG C B 100 74 1493
RUMP O 100 74 2333
RUNDLE W T A 100 65 0067
RUPP F III 200 75 2920
RUSSELL J 400 70 0579
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RUSSELL P 200 71 0667
RUSSELL W 400 65 0485
RUSU O 500 75 3244
RUSZLER P L 100 69 0040
RUTGERS STATE UNIV 300 73 1362
RUTZ D A 200 75 2588
RYLAND D W 300 73 3029
SABEN H S 100 71 2551
SABEY B R 200 74 1991
SAFLEY L M 100 76 3487
SALLAI E 500 75 3247
SALLVIK K 200 74 3369
SALTER P J 100 67 0041
SANCHEZ S A 400 73 1593
SANDERS R 400 73 1822
SANDS D C 100 73 3009
SANG J P L 100 73 3324
SANNER W S 200 72 1360
SANSOM R L 300 74 2825
SARKAR P C 100 73 3470

# AUTHOR INDEX

SATTERWHITE M B 200 72 1302
SAUNCERS R M 100 71 0569
SAVAGE H P 100 72 2110
SAVAGE J E 100 60 2518
SAVAN M 100 71 0742
SAVANNAH R ECOL LAB 300 71 1126
SAVERY C W 100 71 1491
100 72 2800
SAVITZ J 100 73 2226
SAVOS M G 300 72 2268
SAXON J R 200 70 0251
200 71 0825
SAYLCR W W 300 73 1856
SCALF M R 200 70 0498
200 70 0698
200 71 0709
300 72 1085
600 71 1349
300 73 1483
SCARHOROUGH J H 700 70 1109
SCARBROUGH J H 100 71 0304
100 72 1798
SCHAEFER M L 100 71 0572
SCHAFFER W H 200 74 2010
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SCHAKE L M 200 73 1648
SCHANBACHER F L 100 76 3187
SCHAPLER F L 600 73 1589
SCHEFFERLE H 100 65 0699
SCHEFFERLE H E 100 66 0290
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100 65 0503
SCHELTINGA H M J 200 66 0156
200 70 0253
100 66 0347
100 69 0355
100 73 3416
SCHERB K 100 71 3452
SCHILLING F E 100 73 2816
SCHLESINGER M C 200 72 1360
SCHLEUSFNER P E 200 71 0608
SCHLIEKELMAN R J 200 69 0559
SCHLOTTFELDT C 200 75 2705
SCHLOUGH D A 200 73 1332
400 73 1740
600 72 2195
300 74 2215
100 73 2218
200 75 2712
SCHMER F A 300 73 3029
SCHMID L A 200 69 0164
200 69 0564
200 71 0778
300 73 2208
300 71 2387
300 75 2494
200 75 2659
100 75 3223
SCHMISSEUR W E 200 66 0126
SCHMITT L W 200 74 2020
SCHMITZ F L 100 68 0090
SCHNABEL R R 300 75 3484
SCHNEIDER A D 600 74 1756
SCHNEIDER D L 100 71 0464
SCHNEIDER R 200 73 2441
SCHOENBURG R D 100 67 0501
SCHOLFIFLD F B JR 700 69 2225
SCHOLZ D C 600 73 1364
SCHOLZ H G 200 71 0768
SCHOTTMAN R W 200 75 2701
200 75 2708
SCHRAUFNAGEL F H 200 69 0521
SCHROCK M D 600 75 2901
SCHROEDER G L 100 75 3341
SCHROEDER J P 400 75 2866
SCHULTE D D 200 71 0781
200 70 1113
100 72 1913
200 74 2009
200 75 2655
200 75 2704
200 75 2911
200 76 3402
200 76 3413
100 75 3429
300 74 3522
200 76 3530
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SCHULTZ D A 200 70 0226
SCHULZ F 100 72 3349
SCHULZ V H 100 70 2821
SCHUMACHER P W 600 73 1378
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600 75 3506
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SCHWARTZ K J 200 75 2684
SCHWARTZ W A 200 66 0438
SCHWENGEL F 200 71 0610
SCHWIESOW W F 300 68 0352
300 71 0584
200 71 0597
200 71 0804
100 74 1494
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600 71 2199
SCOTT D 100 73 1088
SCOTT M C 400 73 1534
SCOTT M L 400 72 2510
SCOTT T W 200 71 0649
200 72 1303
300 74 1758
100 75 2813
SEARLE L 400 74 1626
400 73 1778
SECKLER D 200 75 2918
SECKLER D W 200 75 2596
SEIER L 100 72 2509
SEIM E C 100 73 1446
100 73 1663
SELF M L 100 75 2410
600 75 2885
SELL J L 100 69 0058
SELTZER W 100 69 0707
SENN C C 400 75 2547
SENN C L 200 72 1386
300 73 1764
SETH S P 100 72 3461
SEWELL J I 200 71 0799
200 72 1108
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300 75 3178
300 75 3179
100 76 3300
300 70 3314
200 74 3393
600 74 3516
SHADDUCK G 300 75 3454
SHADY A M 100 76 3441
SHADY A M A 700 73 2584
SHAEFFER J R 200 71 0286
SHAFFER R E 300 70 1192
SHAKLEE W E 100 73 3427
SHANKLIN M D 600 75 2902
SHANNON D W F 100 69 0364
100 74 3527
SHARIF M 100 74 3539
SHARMA R M 100 69 0714
SHARPLESS R 100 73 2121
100 74 2242
SHARPLESS R G 200 72 2997
SHAW B G 100 73 2254
100 74 2258
SHAW F R 100 65 1091
100 65 1750
SHAW J H 400 69 0419
SHAW M D 200 75 2616
SHEFFIELD C W 200 70 0727
200 70 0755
SHEPPARD C C 300 70 0204
300 71 0621
300 71 0625
300 71 0626
200 71 0815
200 72 1289
200 74 2004
200 75 2605
200 75 2651
200 75 2721
300 75 3050
300 75 3051
SHERMAN M 100 73 1165
100 67 2264
SHERRITT G W 200 75 2693
SHERROD L B 300 74 2219
200 75 2648
SHERWOOD D H 100 76 3504
SHIELDS L 100 75 3012
SHILLING W C 300 75 2981
SHIMKO A N 100 73 1591
SHINDALA A 100 71 0304
100 72 1798
100 73 1833
SHIRLEY R 200 75 2719
SHIROYAMA T 100 75 3141
SHORTALL J G 100 74 3002
100 75 3188
SHOWALTER D H 100 75 3001
SHU C S 600 74 2285
SHUBERT C H 600 75 2559
200 75 2614
SHUTT J W 200 75 2720
SHUTT P 200 74 2149
SHUTT P R 200 74 2139
SHUYLER L R 600 71 1349
300 73 1368
300 72 1396
300 73 1465
300 72 2089
700 69 2227
200 75 2645
200 75 2685
200 72 3455
SHWALUK L 200 75 2704
SIDWICK J H 100 72 3036
SIEGEL R S 100 75 2272
SIEPER E G 100 74 1493
SIEVERS D 300 75 3027
SIEVERS D M 200 75 2718
200 75 2739
600 75 2902
200 75 2909
600 74 3375
SIMON J 100 75 3334
200 74 3367
SIMONS C 200 74 2027
200 75 2731
SIMPSON E C 100 71 1039
100 72 1519
SIMPSON J R 200 70 0241
SIMS F 100 73 1806
SINGER R M 100 71 0443
SINGH I P 100 70 0024
SINGH M 100 73 3470
SINGH P 100 70 0570
SINGH R B 100 72 2500
SINGH V P 300 72 1070
SINGLEY M E 100 73 1508
200 75 2620
200 75 2727
200 75 2920
SIPILA P 200 75 3181
SITKO M 500 75 3249
SKAGGS R W 200 72 1293
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SKARP SVEN-UNO 200 75 2692
SKINNER J 200 69 0528
SKINNER J L 400 71 0456
200 71 1979
SLANE T C 200 75 2591
SLETTEN D 100 71 0443
SLINGER S J 100 70 0027
SLOAN D R 100 73 1495
SLONEKER J H 200 72 1030
200 72 1354
600 74 1748
600 74 1916
100 74 2932
200 75 3370
100 75 3415
SMAJSTRLA A G 600 74 1961
SMALL W E 100 71 1872
SMALLBECK D R 200 75 2679
SMART L I 300 68 1948
SMART P 200 70 0728
200 75 2640
SMAUS R J 100 72 1235
100 73 1391
700 72 2409
SMITH D D 200 75 2685
SMITH E F 300 68 1948
SMITH F F 400 75 2547
300 73 2867
SMITH G E 200 71 0279
200 69 0427
200 69 0429
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200 64 2182
600 2777
SMITH G L 200 73 1082
SMITH G R 400 68 0038
SMITH I C 300 73 1622
SMITH J L 600 73 1609
600 73 1609
200 74 1986
600 75 2492

# AUTHOR INDEX

SMITH J L 200 75 2755
600 76 3227
SMITH K L 100 76 3187
SMITH L W 200 69 0169
100 70 0342
200 71 0851
200 73 1093
200 72 1357
100 73 1773
300 73 1874
300 71 1903
200 75 2641
100 76 3372
SMITH N 200 75 2908
600 75 3016
SMITH P 100 73 1448
200 73 3533
SMITH R E 200 71 0843
600 72 1001
400 73 1373
600 73 1616
300 74 1782
100 71 1910
300 72 2367
600 75 2970
SMITH R J 200 70 0248
700 71 0761
200 71 0803
200 72 1284
200 73 1526
700 67 1651
200 74 2020
600 67 2205
200 73 2479
200 75 2713
200 75 2738
300 75 2824
600 75 2836
600 75 2885
100 75 3017
100 74 3021
300 73 3121
200 74 3380
600 74 3516
SMITH S M 200 64 0759
200 64 2567
SMITH T R 200 69 0433
SMITH V L 600 74 1751
SMITH W E 300 74 2173
SMITH W M 400 71 0293
SMYSER C F 100 70 0110
100 69 0376
SNEATH R W 100 75 3404
SNEED R E 200 75 2633
200 75 2753
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SNETHEN C D 700 71 1766
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SNOEYENBOS G H 100 70 0110
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SOBEL A T . 400 70 0091
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200 66 0143
200 69 0189
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300 69 0631
300 69 0633
300 69 0635
200 71 0658
300 71 0671
300 71 0673
100 71 0674
300 71 0674
300 71 0675
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200 72 1280
200 72 1311
200 64 1698
100 71 1904
200 63 2159
100 66 2513
300 73 2876
200 74 3385
200 74 3388
SOBHAN-ARDAKANI M 300 70 0475
SOIL CONS SER HAWAII300 74 2927
SOLLENBERGER G 400 74 1562
400 75 2334
SOLOMON J 100 72 1427
SOMMERFELDT T G 100 73 1444
SOOD S M 100 73 3315
SOONG R 100 72 2509
SORG T J 100 70 2389
SOTIRACOPCULOS S 200 74 2008
SPAHR S L 300 70 0455
SPARLING A B 200 75 2655
200 75 2911
200 76 3402
100 75 3429
SPEECE R E 100 73 1673
SPENCER W F 100 74 2131
SPIER S L 200 74 3363
200 74 3364
SPILLMAN C K 100 74 2069
700 63 2233
SPLINTER W E 200 72 1025
SPLITTS TOSSER D F 200 71 0642
SPURGEON W I 200 75 2749
SRINATH E G 300 73 1873
200 74 2026
600 72 2106
300 74 3373
200 74 3386
SRINIVASAN M R 100 74 2802
ST AMANT P P 300 70 0487
100 70 1611
STAFFORD D A 100 74 2184
STALEY L M 200 71 0801
200 71 0822
STALHEIM H V 300 75 3191
STALLCUP O T 100 75 3012
300 74 3151
STALLINGS J L 400 74 1919
STANEK G 200 71 0277
STANLEY M A 100 73 1755
STANLEY R A 200 75 2683
STAPLETON P 100 76 3422
100 75 3523
STEAD F M 100 67 1218
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STECKEL J E 200 70 0215
STEELE J H 200 66 0118
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STEELMAN C D 100 70 0420
STEENHUIS T S 200 75 2672
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STELLRECHT M 300 72 3083
STEMBERGER A P 200 71 1406
STEPHENS D F 200 68 0760
STEPHENS E R 300 69 0467
300 71 2286
STEPHENS G R 200 73 3532
STEPHENSON D A 200 71 1964
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STEVENSON F J 500 70 0393
STEVENSON J S 600 72 1954
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300 75 3219
STEWART B R 300 74 1794
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STONE M L 200 75 2687
600 73 2928
STONEBERG E G 600 71 1727
STORK E J 100 70 0017
STOUT P R 100 74 2253
100 75 2272
300 74 2883
STOVER E L 100 76 3480
STRATTON F E 100 69 0679
STRAUB C P 300 71 1058
STRAUCH D 500 75 3242
STRAUMAN E 600 73 1364
STREET J C 300 70 2497
STREETER C L 100 74 1493
STRITZKE R D 600 74 1888
STROH R C 600 75 3015
STROSHINE R L 200 71 0787
200 71 0810
STUART D G 100 71 1212
STUBBLEFIELD T M 200 66 0150
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STUEDEMANN J A 200 71 0853
200 75 2664
300 72 2875
STUEDEMANN J A 500 74 3005
500 74 3213
200 74 3418
SUKOVATY J E 100 74 2491
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SULLIVAN R J 300 69 0317
SUMMERFELT R C 300 74 1914
300 72 2090
SUMMERS J D 100 75 3477
SUMMERS R 200 75 2740
300 3010
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SURBROOK T C 300 70 0208
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SUTTON A L 200 73 1317
200 74 2007
200 74 2032
200 75 2621
200 75 2636
300 75 2874
600 74 2898
300 74 3319
300 76 3519
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SWACKHAMER G L 200 71 0612
SWADER F N 200 70 0214
200 71 0642
SWANSON M H 400 74 1613
SWANSON N 400 73 1158
SWANSON N P 200 70 0216
200 70 0224
200 71 0703
200 71 0775
200 72 1022
100 71 1312
100 73 1382
200 73 1412
200 73 1417.
200 73 1418
200 73 1419
100 74 1535
100 73 1664
100 74 1821
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100 73 2051
300 72 2086
100 74 2130
100 73 2447
200 73 2473
100 74 2491
200 75 2608
200 75 2661
200 74 3382
SWANSCN R 200 75 2627
SWEAZY R M 600 73 1496
300 74 1900
200 72 2168
SWEETEN J 400 73 1475
SWEETEN J M 300 71 0301
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100 73 1340
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200 73 1513
300 73 1617
300 74 1629
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200 75 2691
300 73 3068
600 76 3262
300 76 3267
400 76 3481
SWINE HOUSING SUBCOM300 72 1470
SWITHENBANK C 100 71 1216
TAEUBER C 200 71 0278
TAFT P A 200 64 1693
TAIGANIDES E P 200 69 0055
100 69 0057
200 69 0194
200 71 0281
100 66 0437
100 64 0474
200 71 0769
200 71 0787
200 71 0791
200 71 0792
200 71 0802

# AUTHOR INDEX

TAIGANIDES E P 200 71 0810
200 71 0814
200 69 1167
200 72 1292
200 72 1358
100 74 1462
100 70 1466
300 64 1631
600 67 1780
600 69 1841
200 63 2158
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100 63 2581
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200 75 2707
200 75 2720
200 75 2744
200 75 2747
200 73 3399
100 76 3443
TAKAMIYA G 100 73 1184
TAMASI G 500 75 3245
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TANAKA T 200 75 2705
TANAYAMA S 100 71 0303
TARCZYNSKI ST 500 75 3251
TASK GROUP 2610P 100 67 0079
TAUKABONG T M 700 73 2792
TAYLOR A W 100 71 1039
400 67 1226
TAYLCR B 100 70 0570
TAYLCR G S 200 66 0131
TAYLCR J 100 72 3298
TAYLCR J C 200 71 0609
200 71 0844
100 75 2986
TAYLCR R B 200 69 0199
TAYLOR R G 100 73 1660
TAYLCR R J 100 69 0416
TEAGUE H S 100 69 0316
TEAGUE P W 100 76 3528
TEETER H M 200 72 1027
TEL C A 100 73 2812
TELLER C J 400 70 1478
TEN HAVE P 200 71 0839
TENPAS G H 200 73 1331
200 73 1332
400 73 1740
200 71 1977
600 72 2195
300 74 2215
100 73 2218
200 75 2712
TEOTIA J S 100 71 1588
100 73 1747
100 73 1801
100 74 2189
TERWILLEGER A R 200 75 2729
TETER N C 200 73 1421
200 72 1442
THACKER F E 100 73 1905
THAER R 200 75 2730
THANH N D 300 75 2852
THATCHER T O 100 74 2189
THAYER D W 100 74 3471
100 74 3473
THCMAS H R 300 74 2528
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300 72 1561
200 75 2660
300 75 3219
THOMAS J W 300 70 0213
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200 71 0849
100 72 1529
100 72 1533
THOMAS R B 100 74 3224
THOMAS R E 100 70 0299
200 66 0438
300 74 1876
THCMASCN I J 300 76 3320
THOMPSON D I 100 71 0444
THOMPSON P D 100 68 0287
THOMPSCN T L 200 72 1442
THOMPSON W 400 75 2935
THORBURN T L 200 74 2149
THORESON C W 200 75 2708
THORPODSGARD P E 700 70 2781
THORPE V A 100 71 1221
THYGESON J R 200 71 0813
THYSELIUS L 100 74 2430
TIARKS A E 100 74 2515
TIARKS A E 100 75 2891
TIEDE J E 200 71 0796
TIEDJE J M 200 71 0827
200 72 1297
300 74 2388
TIETJEN C 200 66 0155
200 75 2682
200 75 2907
TILLSON S A 100 70 0064
TIMMONS D R 500 70 0388
100 70 0417
TIMMONS F L 500 70 0397
TIMMONS J F 200 71 0283
500 70 0409
TINNIMIT P 100 72 1529
TINNIMITT P 100 72 1533
TODD D K 300 74 2576
500 75 3451
TOETZ D W 200 71 1234
TOKARZ M B 200 76 3530
TOMESCU V 500 75 3244
TOMLINSON T E 100 71 1197
TOPNIK B H 200 75 2655
TOPPS J H 100 71 3374
TORRENS R L 200 72 1054
100 72 1235
100 73 1391
TOTH S J 200 71 0659
200 72 1361
200 75 2727
TOWER B A 100 69 0360
TOWNSHEND A R 100 70 0083
200 69 0175
TRAIN R E 300 74 2825
400 75 2935
TRAKULCHANG N 100 75 2427
100 75 2536
TRANQUILLI J 200 73 2439
TRANQUILLI J A 700 74 2766
TRAULSEN H 100 72 2817
TRAULSEN V H 100 70 2820
TRAVIS D O 100 71 0681
700 70 1680
TRAVIS T A 100 72 1530
100 73 1542
100 73 2447
100 75 2543
200 74 3365
TRIBBLE L F 200 73 1789
TRNOVSKY M 300 74 2827
300 74 2828
TROON I J 400 70 3294
TROUT T 200 74 1986
TSAO G T 300 71 1119
TSAO TER-FUNG 700 72 2390
TSENG E 200 75 2657
TUCKE A M 100 76 3441
TUCKER R B 300 72 2522
TUCKER J F 100 75 3460
TUCKER R E 200 71 0847
TUCKER T C 100 73 1162
TUNNEY H 200 75 2752
TURK M 200 72 1355
TURMAN E J 200 68 0760
TURNBULL J E 200 71 0772
TURNBULL R 200 69 0550
TURNER D O 400 71 0731
200 71 0784
200 74 1548
200 75 2750
300 76 3284
TURNER E C JR 100 75 2838
TURNER G M 600 72 1514
TURNER H A 100 75 3524
TURNER M E 100 65 0346
500 68 1259
TUSS J 200 69 0534
TWEDT R M 100 74 3127
U S COMM GOV OPERA 300 73 2826
ULICH W L 200 75 2694
200 73 2949
UNDERHILL D B 100 75 3048
UNDERWOOD C 400 68 0033
UNGER P W 100 74 2252
UNITED KING MIN 300 73 2407
UNIV OF WISC EXT SER200 69 0516
UPCHURCH W 400 76 2939
UPHILL P F 100 73 1550
UPHOLT W M 200 71 0280
US DEPT OF AGRI 400 71 2269
400 71 2270
400 71 2271
USDA ANIM WASTE SUBC300 76 3039
USDA ERS 300 74 2959
USDA SCS 200 71 1925
300 75 3020
USDA-ARS AN SCI DIV 300 71 0511
USDI FWPCA 200 69 0423
300 68 0702
UTLEY P R 100 71 0441
UTLEY P R 100 75 3064
UTTORMARK P D 300 74 1860
VAIGNEUR H O 200 75 2670
VALLICOTT D R 300 71 0752
VAN ARSDALL R N 300 72 1775
200 74 2002
VAN DAM J 400 68 0101
400 71 0753
VAN DER LEEDEN F 300 75 2339
VAN DIJK H 200 75 2678
VAN FAASEN H G 200 75 2678
VAN FOSSEN L D 600 71 1719
600 71 1723
VAN GEELEN M 200 74 2035
VAN NESS G B 200 75 2589
VAN RIET W J 300 75 3482
VAN VOLK V 300 72 2261
VAN ZUTPHEN J P 200 73 3321
VANDEBERG G 200 69 0536
VANDEPCPULIERE J M 200 75 2665
400 76 3131
VANCERHOLM D H 100 70 0458
600 73 1710
600 74 1744
300 73 1825
700 69 2312
200 75 2669
400 75 2846
600 75 2849
300 73 2993
400 76 3331
VANDERLOO K J 100 75 2365
VANDONSEL D J 100 71 0484
VARGA G A 200 75 2653
VARGHESE S 300 71 0628
VARNEY K E 100 72 1480
100 72 1600
100 73 2962
VEATCH J O 300 64 1110
VEIRS C E 200 71 0586
VELEBIL M 200 71 0771
VELCSO J R 300 73 1849
VENABLE R 300 72 3083
VENN J A J 200 70 0238
VERDUIN J 500 70 0390
VERLEY W E 200 73 1320
100 74 1855
300 74 2382
200 75 2717
VERMES L 500 75 3243
VERTREES J G 200 72 1353
VETTER R 200 74 2468
VETTER R L 300 74 2452
600 75 2836
300 72 3026
VEZEY S A 200 75 2642
VICKERS A F 200 69 0163
VICKERS K D 700 72 1537
VIETS F G 300 70 0414
200 71 0605
100 72 2235
VIETS F G JR 100 67 0076
100 69 0103
400 71 0435
100 71 0589
200 69 0676
100 68 0730
300 67 1250
100 71 1312
100 73 2249
300 74 2255
100 71 2424
300 75 2837
VILSTRUP R H 200 69 0537
VITOSH M L 100 73 2277
VITTETOE G C 200 75 2609
VOLK B G 200 74 2971
VOLK V V 200 74 1548
VORHIES M W 300 75 3145
VOSS R D 200 73 2485
WADLEIGH C H 500 70 0386
300 68 1043
100 68 1121
400 69 1225
WAGNER G H 500 70 0393
WAGNER W D 100 70 0691
WAIMAN H E 100 75 3460
WALAWENDER W P 300 73 1372
300 73 1907
300 72 2313
300 73 2498
300 74 2887
600 74 2984
WALDROUP P W 400 74 1772
WALKER J P 200 69 0187
100 71 0266
WALKER K C 100 68 1121
WALKER T W 100 70 2794
WALKER W H 200 72 1399
300 73 1515

# AUTHOR INDEX

WALKER W R 200 70 0225
100 70 1505
WALLACE H D 300 75 2852
WALLINGFORD G 700 74 3525
WALLINGFORD G W 200 72 1301
300 73 2043
100 73 2113
300 73 2208
100 75 2490
300 75 2495
200 75 2748
100 75 2926
100 74 2958
100 75 2994
100 75 3069
100 75 3401
WALSH L M 200 71 0833
100 72 1435
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300 75 2507
WALTER J M 200 74 1527
WALTER M F 600 74 1712
200 74 1777
700 74 2362
WALTER W G 100 71 1212
WALTNER E 400 73 1811
WALTNER W 400 73 1811
WALTON F 200 75 2605
WALTZ F A 300 73 3029
WANG H H 200 75 2656
WANG J 600 74 1958
WARD D 300 71 0591
WARD G M 400 73 2287
200 75 2647
200 75 2918
WARD J C 200 69 0193
600 69 1160
WARD R C 600 75 2492
200 75 2755
WARDEN W K 400 73 2067
WARKENTIN B P 600 73 1394
WARNER A F 200 66 0140
WARREN E P 100 76 3504
WARREN G 400 73 2098
WARRICK A W 100 75 3260
WASHBURN K W 100 73 1315
WASHINGTON UNIV 100 70 1051
WATKINS R 400 76 3542
WATSON D M 100 72 3036
WATSON F D 100 72 3036
WATSON H 300 72 2105
200 75 2617
WATSON J R 400 71 1486
WATSON S 100 70 1037
WATTS A B 100 73 1164
WAYBRANT R 200 74 2148
WEAVER W D JR 400 73 1393
WEBB D E JR 300 74 2934
WEBB H J 100 62 1220
WEBB K E 200 71 0847
WEBB K E JR 100 74 1950
100 75 2244
100 75 2419
300 74 2526
300 74 2527
200 75 2652
100 75 2830
100 75 2943
100 75 3231
300 75 3351
300 75 3352
300 75 3353
300 75 3354
300 75 3355
WEBB T F 300 73 1468
WEBBER L R 100 69 0052
100 66 0063
200 69 0174
100 68 0452
100 71 0507
200 68 0724
400 69 1045
400 73 1073
100 73 2812
WEBSTER N W 200 66 0134
WEED S B 300 74 3047
WEEDA W C 100 73 3417
WEEKS M E 200 72 1300
WEETH H J 100 71 0257
WEHBY A J 100 71 0572
WEHUNT X E 400 60 1596
WEIBEL S R 100 69 0375
WEIDNER R B 100 69 0375
WEIL M 200 75 2714
WEINBERGER L W 200 69 0158
WEINER B A 100 74 3025
100 74 3150
WEINLAND B T 100 76 3372
WEISHEIT H 600 72 1148
WELCH C D 300 76 3267

WELCH F M 200 69 0056
WELLER J B 200 70 0246
WELLS D 300 1792
WELLS D M 100 69 0071
200 69 0165
200 69 0183
200 70 0232
600 70 0255
600 70 0250
300 71 0538
100 71 1038
300 69 1180
200 72 1296
600 73 1496
300 71 1739
200 71 1926
200 72 2174
300 74 3208
WELLS G D 300 71 1236
600 73 2052
WELSH F W 200 76 3413
WELSH S K 600 74 1952
WEN C Y 100 73 1343
WEN CHIN YUNG 600 73 1746
WENDER I 300 71 1081
300 70 1084
WENGEL R W 600 72 1893
WENNBLOM R D 400 76 3105
WENSINK R B 600 75 2537
300 75 3149
600 76 3254
WERNER J A 300 70 1104
WESCOTT R B 100 70 0362
WESLEY R L 200 71 0617
200 71 0842
WESTERMAN P W 100 76 3269
WESTING T W 200 74 2018
WESWIG P H 600 1383
300 73 1474
WETHERILL G D 200 75 2633
WETMORE A 200 71 0733
WHEATLAND A B 100 70 0089
400 64 0358
WHEATON H N 200 75 2665
WHEATON R Z 100 69 0071
200 69 0165
200 69 0183
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600 76 3500
WHELDEN H C JR 300 72 1603
WHENHAM G R 100 68 1469
WHETSTONE G A 600 73 1496
300 74 3208
200 74 3409
WHETSTONE T M 100 73 1467
WHIPPLE R 400 71 3508
WHITE C 100 70 0581
WHITE G M 100 76 3291
100 76 3292
WHITE R K 100 69 0057
200 69 0194
200 71 0792
200 71 0802
200 71 0810
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200 75 2720
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300 75 3336
200 74 3384
200 74 3394
200 73 3399
WHITE T W 100 74 1472
WHITLEY J R 500 70 0406
WHITNEY D A 300 73 2043
WICKERSHAM E W 100 69 2808
WIDDOWSON F V 100 74 2340
WIDEMAN W S 200 74 2185
WIEBEL J 400 76 3493
400 76 3494
WIECZOREK A W 700 73 2212
200 75 2701
WIEGAND C J W 200 72 1275
WIERSMA J L 600 73 1589
200 75 2662
300 76 3403
WIERSMA J N 300 75 3484
WIETING C R 700 64 2768
WILBORN E 400 74 1612
WILDUNG R E 100 69 1659
WILEY J S 400 64 0379

WILEY J S 200 63 2165
WILKE J T 100 69 0061
100 68 0090
WILKE P I 100 71 2760
100 71 2761
WILKINS R J 100 69 0045
WILKINSON B H 400 75 2560
WILKINSON D E 200 71 1965
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WILKINSON S R 100 71 0509
200 70 0720
200 71 0855
100 75 2944
200 75 2664
300 72 2875
500 74 3005
500 74 3213
200 74 3418
300 74 3403
WILL L A 100 73 1685
200 74 3363
200 74 3364
WILLARDSON L S 600 69 1239
WILLEMS D 200 69 0553
WILLEMS D G 300 70 1014
WILLET L B 100 76 3187
WILLEY C R 200 72 1293
WILLIAMS D J 200 70 0719
200 70 0720
200 71 0853
200 75 2664
300 72 2875
200 74 3418
WILLIAMS D W 600 74 3240
WILLIAMS H R 400 68 0229
WILLIAMS J B 100 67 0041
WILLIAMS O D 300 72 3079
WILLIAMS R J B 100 70 1233
WILLIFORD J W 300 71 1598
WILLIS C E 200 75 2591
WILLITS D H 100 76 3291
100 76 3292
WILLRICH T L 100 70 0102
200 66 0137
500 70 0399
200 71 0788
200 74 1548
600 71 1592
200 63 2162
300 76 3160
WILLS J B 300 75 3177
WILLSON G B 200 69 0192
400 71 0309
200 71 0793
200 71 0804
200 71 0806
200 72 1277
200 73 1337
100 74 1494
600 72 1953
200 75 2724
200 75 2726
600 72 3344
WILLSON W G 100 74 3290
WILMORE R 400 69 0039
400 72 1731
WILSON A D 100 73 1538
WILSON L L 300 73 1856
200 70 2391
WILSON P M 200 75 2700
WINDELS M F 300 72 2369
WINDT T A 200 71 0801
200 71 0822
WING J M 200 70 0221
200 71 0856
WINTER A R 100 61 2505
WINTER R E 100 74 2057
WINTERHALDER B 100 74 3224
WIS DPT OF NAT RES 300 72 3084
WISCHMEIER W H 300 75 2880
WISCONSIN UNIV 200 71 1962
WISE G G 600 73 1614
300 73 3118
WISE G G III 700 72 1706
WISSMULLER K 100 70 2821
WITHEROW J L 200 70 0498
200 71 0709
200 70 1118
600 71 1349
400 71 1985
WITHER W B 100 74 1894
100 72 1960
WITTHUSS H 200 72 1014
200 73 1414
WITTHUSS H D 300 75 2951
WITZ J A 200 71 0705
600 72 1153
WITZ R L 100 69 0058
600 74 1847
600 73 1852

# AUTHOR INDEX

WITZ R L 100 71 2351
WITZEL S 300 68 1122
WITZEL S A 100 70 0042
100 69 0061
100 68 0090
200 66 0116
100 71 0261
100 65 0334
200 69 0482
100 71 0571
600 69 2179
100 70 2381
WOLF D C 100 65 2542
200 75 2674
WOLF R 400 75 3162
WOLFE R R 100 68 1579
WOLFGRD J 300 70 0207
WOLFORD J H 300 75 3052
300 75 3053
300 75 3056
300 75 3057
300 75 3058
300 75 3059
WOLFSON D E 200 72 1360
WONG-CHONG G M 100 74 2223
200 75 2705
200 75 2913
700 74 3113
WOOD A J 100 70 0362
WOOD J M 100 69 0445
WOOD W W JR 400 75 2547
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WOODING N H 300 71 0457
WOODRUFF N P 400 74 3518
WOODS J L 200 75 2734
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WOODS W D 100 60 2518
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200 71 0776
100 72 1129
200 72 1282
WOODS WALTER 300 72 1314
WOOLHISER D A 300 75 2880
WOOTEN J W 200 71 0808
WPCF MAN FORCE 100 71 1796
WRIGHT C V 200 63 2166
WUNZ E C 600 73 1623
WURTZ C B 600 68 1161
YAMAGUCHI M 200 75 3180
YAMAMOTO T T 200 71 1459
YAMASHITA G 600 73 1365
YANG P Y 300 74 1758
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YATES J C 200 71 0615
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YECK R G 200 71 0608
200 71 0762
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200 75 2641
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YIH R Y 100 71 1216
YIN S C 300 74 1914
YORK L R 100 70 0020
YORK M D 100 70 0018
YOSHIMURA P 200 71 1454
YOUNG H D 200 73 2950
YOUNG H G 100 74 1894
YOUNG J 300 72 2087
YOUNG L L 100 72 1557
YOUNG R A 200 74 2030
600 76 3220
YOUNG R H F 100 73 1184
100 74 2585
YOUNG R J 200 71 0663
200 70 0715
200 70 2394
YOUNGER R L 100 73 2354
YOUNKIN D E 200 75 2693
200 75 2696
100 76 3192
YU YU 100 72 1529
100 72 1533
YUSHOK W 300 48 2414
ZABLATZKY H R 100 68 0306
ZALFA A A 100 69 1042
ZALL R R 100 72 1193
ZANI G 100 74 2923
ZEIKUS J G 600 75 2894
ZERFAS J W 200 71 0796
ZIEGLER S J 200 74 2001
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ZINDAHL R L 100 76 3239
ZINDEL H C 100 70 0020
ZINDEL H C 300 70 0205
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300 70 0209
300 70 0210
300 70 0211
300 70 0212
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300 71 0622
300 71 0623
300 71 0624
300 71 0627
300 71 0628
200 71 0815
200 71 0848
200 71 0849
300 72 1182
400 73 1389
400 74 1502
100 72 1533
200 69 1040
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200 74 2152
400 72 2299
200 75 2605
200 75 2651
400 71 3211
100 74 3288
200 74 3393
100 74 3505
ZMOLEK W G 600 71 1726
ZUROWSKI T 400 73 1068
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ZWERMAN P J 200 69 0201
200 70 0227
200 71 0649
200 72 1304
200 74 2011
300 75 3038
100 76 3259
100 76 3275

## SECTION 4

## ANIMAL INFORMATION CATEGORY INDEX/CATEGORIES OF ANIMAL INFORMATION

| Interest Area | Topic Area |
|---|---|
| A. Environmental Effects | 1. General |
| | 2. Surface Runoff from Animal Production |
| | 3. Surface Runoff from Agricultural Watersheds |
| | 4. Surface Water Pollution |
| | 5. Groundwater Pollution |
| | 6. Odor |
| | 7. Air |
| | 8. Soil Systems |
| | 9. Biocides |
| | 10. Vectors |
| | 11. Animal Health |
| | 12. Public Health |
| | 13. Aesthetics |
| B. Management of Animal Production and Confinement Operations | 1. General |
| | 2. Liquid Systems |
| | 3. Solid Systems |
| | 4. Storage |
| | 5. Management's Impact on Waste Characteristics |
| C. Characteristics of Animal Wastes | 1. Physical |
| | 2. Chemical |
| | 3. Biological |
| D. Treatment Processes | 1. Physical |
| | 2. Chemical |
| | 3. Biological |
| E. Utilization and Disposal | 1. General |
| | 2. Land Disposal or Reuse |
| | 3. Recycling |
| | 4. By-Product Recovery |
| F. General | 1. Economics |
| | 2. Legalities |
| | 3. Policy Needs |
| | 4. Overviews |
| | 5. Related Agricultural Operations |
| | 6. Research and Development |

# ANIMAL INFORMATION CATEGORY INDEX

A1

0055
0065
0073
0233
0239
0275
0446
0454
0465
0486
0507
0534
0537
0551
0553
0554
0590
0594
0643
0647
0732
0789
0817
0819
1012
1106
1126
1133
1191
1246
1266
1271
1326
1358
1371
1378
1407
1425
1451
1460
1466
1506
1517
1539
1552
1568
1587
1606
1612
1646
1704
1705
1716
1728
1733
1744
1775
1776
1780
1805
1833
1884
1892
1894
1965
1982
1995
2003
2013
2080
2087
2088
2132
2135
2143
2149
2156
2192
2196
2205
2235
2247
2308
2313
2335
2358
2408
2415
2421
2433
2453
2506
2530
2531
2546
2571
2592

A1

2593
2655
2809
2820
2823
2905
2968
3020
3022
3032
3036
3044
3085
3097
3120
3142
3171
3208
3266
3275
3307
3321
3336
3344
3381
3455
3456
3472
3515
3518

A2

0010
0038
0054
0062
0071
0092
0093
0102
0104
0120
0139
0182
0183
0184
0193
0224
0230
0232
0255
0259
0268
0269
0281
0298
0299
0300
0302
0318
0352
0358
0372
0384
0386
0392
0399
0405
0410
0411
0414
0423
0424
0425
0428
0430
0433
0434
0435
0444
0447
0455
0466
0472
0506
0538
0539
0541
0542
0543
0544
0546
0547
0548
0549
0550

A2

0556
0558
0559
0560
0561
0562
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0573
0591
0596
0597
0602
0603
0604
0605
0613
0642
0644
0669
0676
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0681
0684
0689
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0700
0703
0708
0709
0710
0726
0733
0734
0738
0743
0747
0752
0756
0758
0759
0770
0773
0774
0775
0778
0779
0783
0796
0820
1003
1005
1006
1009
1010
1011
1014
1015
1016
1019
1020
1021
1022
1023
1025
1036
1054
1057
1059
1107
1108
1112
1118
1121
1129
1131
1135
1138
1144
1149
1158
1160
1168
1175
1177
1179
1180
1185
1192
1194
1195
1196
1201
1204
1205
1209
1214
1219

A2

1225
1226
1227
1228
1233
1234
1235
1243
1245
1248
1269
1282
1283
1285
1294
1296
1302
1314
1317
1323
1332
1333
1340
1349
1367
1376
1382
1391
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1412
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1416
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1419
1422
1424
1438
1443
1446
1447
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1452
1475
1498
1501
1512
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1540
1543
1551
1555
1556
1565
1570
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1575
1589
1614
1628
1633
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1638
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1781
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1794
1802
1811

A2

1813
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1886
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1920
1928
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1932
1933
1934
1941
1942
1943
1956
1963
1966
1967
1971
1972
1974
1978
1997
1999
2000
2001
2002
2017
2051
2060
2061
2081
2085
2086
2093
2096
2099
2104
2109
2114
2117
2120
2124
2132
2136
2140
2149
2167
2175
2179
2190
2208
2210
2211
2212
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2231
2235
2260
2270
2273
2283
2307
2320
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2382
2386
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2405
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2409
2411
2413
2434
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2444
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2447
2471
2473
2475
2486
2494

A2

2502
2508
2516
2519
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2530
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2563
2565
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2575
2585
2595
2597
2602
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2609
2610
2614
2619
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2632
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2671
2688
2706
2708
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2710
2711
2712
2771
2772
2778
2781
2786
2797
2803
2824
2837
2839
2843
2849
2863
2866
2869
2871
2895
2900
2904
2931
2951
2952
2955
2969
2993
3039
3042
3044
3073
3076
3080
3084
3105
3118
3128
3129
3149
3172
3198
3232
3254
3262
3270
3279
3283
3295
3310
3313
3325
3331
3345
3346
3348
3361
3362
3382
3410
3414
3421
3424
3433
3434
3440

# ANIMAL INFORMATION CATEGORY INDEX

A2

3464
3472
3494
3503
3512
3519

A3

0042
0061
0090
0100
0224
0227
0229
0282
0283
0284
0292
0375
0386
0389
0390
0392
0394
0396
0397
0399
0405
0407
0408
0411
0417
0429
0431
0433
0435
0453
0482
0493
0495
0523
0531
0548
0560
0571
0586
0591
0607
0610
0616
0642
0646
0648
0649
0661
0670
0697
0701
0710
0721
0727
0731
0756
0770
0775
0796
0828
0829
0833
0834
1014
1020
1038
1039
1042
1044
1045
1049
1057
1066
1095
1107
1108
1118
1120
1121
1122
1124
1125
1185
1194
1195
1196
1197

A3

1198
1202
1212
1214
1219
1224
1225
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1228
1233
1243
1267
1304
1366
1435
1438
1443
1551
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1604
1639
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1679
1724
1753
1758
1860
1915
1943
1963
1985
2009
2010
2011
2030
2090
2109
2132
2133
2149
2162
2179
2190
2307
2347
2382
2385
2411
2442
2473
2495
2502
2516
2540
2556
2585
2598
2662
2665
2672
2674
2700
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2748
2751
2753
2758
2782
2811
2861
2880
2889
2897
2921
2969
2973
2979
2980
2981
2982
3040
3049
3112
3116
3179
3210
3219
3220
3259
3277
3281
3284
3307
3309
3319
3343

A3

3359
3362
3440
3500
3506
3515

A4

0002
0031
0032
0037
0038
0042
0046
0051
0054
0062
0063
0069
0071
0073
0079
0083
0093
0102
0103
0104
0114
0115
0120
0144
0157
0158
0160
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0176
0181
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0185
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0204
0205
0214
0217
0218
0221
0224
0225
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0228
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0230
0233
0236
0240
0255
0257
0273
0274
0275
0276
0277
0278
0279
0281
0282
0283
0284
0285
0286
0289
0292
0298
0304
0320
0321
0322
0324
0326
0341
0344
0345
0349
0352
0355
0358
0365
0368
0372
0380
0381
0382
0383
0384

A4

0386
0387
0388
0389
0390
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0394
0395
0396
0398
0399
0402
0405
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0408
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0410
0411
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0417
0423
0424
0425
0426
0428
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0431
0432
0433
0435
0440
0444
0445
0447
0451
0453
0455
0457
0482
0483
0484
0488
0489
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0508
0512
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0600
0604
0605

A4

0607
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0616
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0702
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0757
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0775
0783
0786
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0795
0796
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0807
0820
0828
0839
1003
1005
1008
1009
1010
1011
1013
1016
1020
1021
1033
1036
1037
1038
1039
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1080
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1087
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1099
1100

A4

1103
1105
1106
1107
1108
1110
1115
1116
1117
1118
1120
1121
1122
1124
1125
1126
1137
1144
1169
1175
1181
1184
1185
1186
1192
1194
1195
1196
1197
1198
1200
1201
1202
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1204
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1274
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1446
1449
1461
1475
1476
1498
1499
1503
1505
1513
1515
1524
1540

# ANIMAL INFORMATION CATEGORY INDEX

A4

1544
1552
1560
1565
1570
1574
1584
1634
1638
1656
1658
1663
1665
1678
1690
1697
1715
1720
1724
1733
1753
1764
1770
1775
1776
1779
1781
1782
1785
1786
1794
1814
1830
1831
1832
1838
1850
1863
1872
1879
1882
1889
1895
1896
1914
1915
1925
1932
1934
1936
1957
1962
1963
1966
1967
1968
1970
1996
1997
1998
1999
2001
2002
2003
2009
2017
2042
2062
2068
2076
2078
2084
2089
2090
2098
2104
2105
2111
2132
2133
2140
2141
2142
2148
2153
2162
2163
2174
2179
2182
2192
2193
2196
2199
2203
2209

A4

2211
2220
2232
2241
2255
2257
2263
2270
2290
2292
2307
2320
2333
2347
2366
2376
2378
2380
2381
2383
2386
2392
2393
2394
2396
2405
2407
2429
2434
2442
2444
2446
2451
2467
2497
2502
2506
2519
2523
2561
2565
2567
2571
2582
2585
2595
2597
2599
2600
2602
2603
2604
2618
2623
2626
2639
2674
2700
2739
2742
2748
2754
2755
2763
2769
2773
2781
2799
2803
2818
2825
2826
2839
2866
2867
2880
2883
2888
2904
2921
2929
2931
2936
2951
2959
2960
2965
2973
2980
2981
2982
2993
3013
3020
3029
3039

A4

3040
3042
3043
3049
3073
3075
3076
3077
3078
3079
3080
3081
3082
3084
3095
3096
3096
3100
3105
3107
3110
3112
3115
3117
3118
3120
3136
3141
3142
3147
3151
3179
3180
3182
3185
3189
3198
3210
3226
3232
3241
3242
3248
3252
3266
3274
3279
3281
3295
3297
3307
3308
3321
3325
3326
3327
3331
3346
3362
3378
3397
3398
3410
3416
3421
3434
3440
3451
3457
3465
3467
3472
3478
3494
3500
3512
3525

A5

0002
0016
0031
0046
0052
0060
0062
0063
0070
0071
0076
0081
0100
0102
0114

A5

0115
0157
0158
0160
0174
0175
0181
0198
0204
0205
0214
0216
0217
0221
0222
0224
0225
0228
0232
0233
0236
0240
0259
0269
0274
0275
0276
0277
0278
0279
0281
0288
0320
0324
0326
0344
0349
0365
0368
0372
0383
0391
0392
0393
0394
0395
0396
0398
0399
0402
0404
0405
0408
0409
0410
0411
0414
0423
0424
0426
0429
0431
0432
0433
0434
0435
0437
0447
0450
0452
0453
0457
0466
0482
0490
0498
0508
0512
0516
0517
0518
0523
0526
0527
0529
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0532
0533
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0535
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0542
0543
0546

A5

0548
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0715
0721
0724
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0739
0741
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0756
0758
0770
0782
0788
0798
0828
0830
0832
1003
1008
1010
1013
1016
1020
1021
1036
1037
1041
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1050
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1080
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1103
1106
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1122
1124
1127
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A5

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1930
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1934
1947
1958
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1964
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1967
1968
1970
1978
1987
1997
1998
2003
2033
2051
2062
2076
2078
2082
2084
2086

## ANIMAL INFORMATION CATEGORY INDEX

A5

2104
2105
2108
2127
2132
2133
2153
2162
2163
2174
2175
2179
2182
2187
2192
2196
2206
2211
2227
2237
2245
2255
2260
2270
2280
2296
2339
2366
2376
2378
2381
2382
2394
2395
2396
2413
2447
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2517
2528
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2582
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2673
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2777
2782
2811
2818
2819
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2823
2856
2858
2866
2867
2883
2900
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2952
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2973
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2987
2996
3021
3030
3042
3045
3049
3069
3091
3118

A5

3119
3151
3176
3198
3199
3203
3242
3248
3265
3284
3287
3319
3325
3357
3361
3362
3393
3416
3451
3525
3533

A6

0001
0002
0006
0007
0008
0009
0017
0019
0022
0032
0035
0044
0046
0058
0065
0074
0075
0078
0083
0084
0089
0091
0094
0096
0097
0105
0111
0114
0115
0122
0130
0132
0137
0138
0150
0161
0163
0164
0167
0174
0177
0178
0179
0185
0187
0188
0189
0190
0191
0192
0197
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0199
0202
0203
0204
0205
0206
0208
0218
0225
0228
0233
0234
0236
0239
0243
0244
0254
0259
0262
0266

A6

0281
0287
0295
0296
0298
0300
0304
0309
0311
0314
0316
0317
0319
0321
0323
0324
0326
0331
0332
0334
0335
0337
0338
0339
0346
0350
0353
0359
0363
0366
0368
0371
0379
0381
0386
0390
0401
0414
0415
0426
0434
0435
0437
0442
0443
0447
0448
0455
0456
0458
0467
0469
0470
0472
0477
0478
0480
0483
0494
0500
0509
0519
0522
0523
0524
0525
0528
0534
0541
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0604
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A6

0649
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0682
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# ANIMAL INFORMATION CATEGORY INDEX

A6

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A7

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A7

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A8

0016
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A8

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# ANIMAL INFORMATION CATEGORY INDEX

**A8**

0832
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**A8**

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**A8**

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**A8**

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**A8**

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**A9**

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**A9**

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# ANIMAL INFORMATION CATEGORY INDEX

A9

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2980
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A10

0012
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A10

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A11

0011

A11

0014
0018
0020
0024
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# ANIMAL INFORMATION CATEGORY INDEX

A11

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2464
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# ANIMAL INFORMATION CATEGORY INDEX

B1

0306
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# ANIMAL INFORMATION CATEGORY INDEX

81

2883
2886
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2896
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82

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# ANIMAL INFORMATION CATEGORY INDEX

82

1168
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# ANIMAL INFORMATION CATEGORY INDEX

82

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# ANIMAL INFORMATION CATEGORY INDEX

83

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# ANIMAL INFORMATION CATEGORY INDEX

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# ANIMAL INFORMATION CATEGORY INDEX

C1

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# ANIMAL INFORMATION CATEGORY INDEX

C2

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# ANIMAL INFORMATION CATEGORY INDEX

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# ANIMAL INFORMATION CATEGORY INDEX

C3

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0807
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C3

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D1

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D1

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2103

# ANIMAL INFORMATION CATEGORY INDEX

D1

2107
2111
2132
2134
2146
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2166
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2172
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D1

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D1

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D2

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D2

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D2

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D2

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2983

# ANIMAL INFORMATION CATEGORY INDEX

D2

2984
2986
2992
3015
3020
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3409
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D3

0001
0002
0006
0008
0009
0022
0028
0030
0035
0039
0044
0049
0050
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0101
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0115
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D3

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D3

0443
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# ANIMAL INFORMATION CATEGORY INDEX

D3

1986
1996
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2008
2016
2018
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D3

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E1

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1470

# ANIMAL INFORMATION CATEGORY INDEX

E1

1487
1496
1505
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1512
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1644
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1973
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2202
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E1

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3100
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3107
3142
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3208
3221
3241
3339
3414
3424
3438

E2

0001
0015
0016
0019
0021
0030
0033
0038
0039
0041
0042
0048
0049
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# ANIMAL INFORMATION CATEGORY INDEX

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# ANIMAL INFORMATION CATEGORY INDEX

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# ANIMAL INFORMATION CATEGORY INDEX

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F1

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# ANIMAL INFORMATION CATEGORY INDEX

F1

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# ANIMAL INFORMATION CATEGORY INDEX

F2

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# ANIMAL INFORMATION CATEGORY INDEX

F6

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# SECTION 5

# ABSTRACTS

### 0001 - A6, A7, B1, C1, C2, C3, D3, E2, F1, F2, F3, F4

**SWINE HOUSING AND WASTE MANAGEMENT - A RESEARCH REVIEW,**
National Pork Producers Council; Illinois Univ., Urbana. Coll. of Agriculture.
Arthur J. Muehling.
Department of Agricultural Engineering, College of Agriculture, University of Illinois at Urbana-Champaign, August 1969. 91 p, 232 ref. A. Eng.-873.

Descriptors: *Farm wastes, *Hogs, *Confinement pens, *Aerobic treatment, *Anerobic digestion, Odor, Economics.
Identifiers: *Oxidation ditch, *Housing, Space requirements, Slotted floors, Methods of disposal, Legal implications.

Current and past research in swine housing and waste management is reviewed and summarized. The author utilized 77 references in Part I of the report on swine housing studies. Research on production units, space requirements, slotted floors, and economics of swine housing systems is presented in summary form. Recommendations for future swine housing research are made. 155 references were utilized in Part II of the report on waste management studies. Properties of swine wastes, treatment and return of swine wastes to the land, other methods of disposal, gases and odors, and legal implications of waste handling are summarized. Recommendations for future research in waste management are made. Six fact sheets available from the National Pork Producers Council, Des Moines, supplement the research review. (White-Iowa State)

### 0002-A4,A5,A6,B2,B4 D3

**SWINE WASTE MANAGEMENT-ANAEROBIC LAGOONS,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AENG-877.

Descriptors: *Hogs, *Farm wastes, *Anaerobic conditions, *Lagoons, Size, Sites, Construction, Shape, Depth, Odors, Sludge, Water pollution, Temperature, Intakes, Outlets, Grading, Management, Mixing, Organic matter, Stabilization.
Identifiers: *Loading rates, *Location, Solids, Wind action, Gas bubbling, Volatile solids.

Anaerobic lagoons were first adapted for the storage and treatment of hog wastes because of their low initial cost, ease of operation, and lack of serious alternatives. They have not always been successful, for sometimes they release objectional odors, they can pollute surface and underground water, they sometimes do not decompose the manure adequately, and in time they are apt to fill up with sludge. This fact sheet gives advice as to loading rates, size and location of anaerobic lagoons. Attention is given to the construction shape, depth, inlets and outlets, fencing, and grading of banks. Management practices include an adequate supply of water, correct start-up, continuous loading rates, restriction of solids, and adequate mixing. (White-Iowa State)

### 0003 - B1, B5, F1

**CONFINEMENT SWINE HOUSING - SPACE REQUIREMENTS,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AEng-874.

Descriptors: *Size, *Seasonal, *Temperature, *Ventilation, Farm wastes, Hogs, Confinement pens, Management, Performance, Economics.
Identifiers: *Space requirements, Method of feeding, Number of pigs per pen, Heat stress.

As confinement housing has changed to include total enclosure of feeding and sleeping area under roof, the minimum space requirements recommended for pigs in confinement have been reduced. These recommendations indicate the minimum amount of floor space per pig necessary to prevent a significant reduction in pig performance and to maintain a reasonable degree of cleanliness in the pen. The fact sheet lists space requirements for different weight ranges of hogs. These recommendations are based on research that has considered the more important factors affecting space needs. The factors discussed in the fact sheet include size of animal, season (as related to temperature), ventilation, method of feeding, level of management, and number of pigs per pen. (White-Iowa State)

### 0004 - B1

**CONFINEMENT SWINE HOUSING - SLOTTED FLOORS,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AEng-875.

Descriptors: *Construction materials, *Reinforced concrete, *Metals, Farm wastes, Dimensions, Corrosion, Failure, Durability, Depth, Height, Length, Reinforcement, Hog.
Identifiers: *Slotted floors, *Wood, *Spacing, Expanded metal, Farrowing, Feed wastage.

This fact sheet lists wood, concrete and metal as being effective for slotted floors. Advantages and disadvantages of each type are given, as well as dimensions that should be used. Expanded metal and steel straps are both discussed as to their effectiveness for slotted floors. The amount and kind of reinforcing to use in concrete slats is given. Recommended spacing and advice for farrowing on slotted floors is also given. Pens with totally slotted floors remain consistently cleaner than those partially slotted. In general, the larger the pig the wider the slat that can be used without sacrificing cleaning efficiency. (White-Iowa State)

### 0005 - B1, B5, C1, C2, C3

**SWINE WASTE MANAGEMENT - PROPERTIES OF SWINE WASTES,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AEng-876.

Descriptors: *Farm wastes, *Physical properties, *Chemical properties, *Biological properties, Hogs, Antibiotics, Nitrogen, Potash, Biochemical oxygen demand, Chemical oxygen demand, Nutrients, Animal physiology, Biological treatment.
Identifiers: *Daily production, *Fertilizer value, Phosphoric acid, Population equivalent, Feed ration, Solids.

An understanding of the properties of swine wastes is necessary to develop an adequate system of waste management. The properties of swine wastes as classified by this fact sheet are physical, chemical, and biological. The physical and chemical properties may be affected by the physiology of the animal, the feed ration, and the environment. The quality of feed influences the amount the hogs will eat and the chemical composition of the wastes. The physical properties of daily production and amount of solids are listed by this fact sheet. The fertilizer value of swine manure is shown and the amounts required to obtain certain pounds per acre of nitrogen, potash, and phosphoric acid are told. Average values for BOD, COD and population equivalent are listed as biological properties of swine manure. (White-Iowa State)

### 0006 - A6,B1,B2,B4,C1, C2,C3,D3,F1

**SWINE WASTE MANAGEMENT - OXIDATION DITCH FOR TREATING HOG WASTES,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AEng-878.

Descriptors: *Costs, *Farm wastes, *Hogs, *Design, *Rotors, Effluent, Volume, Storage, Oxygen, Biochemical oxygen demand, Aerobic bacteria, Organic matter, Calibrations, Foaming, Microorganisms, Odors, Dissolved oxygen, Color, Anaerobic bacteria, Sludge.
Identifiers: *Oxidation ditch, Rotor capacity, Rotor immersion, Rate of flow, Configuration, Detention time.

There has been considerable interest in aerobically treating hog wastes in an oxidation ditch because of the need for a low-odor method of manure storage and treatment. This fact sheet gives guidelines as to design shape, capacity and loading, rotor capacity and immersion, liquid depth and rate of flow. Operational procedures are given as well as a discussion of problems that may arise. Solutions to the problem of foaming include vegetable or petroleum oil, commercial products or a water spray. Sludge buildup and final disposal are given some attention. Rotor costs are about $250 per foot and operation costs are estimated to between 1/2 and 1 cent per day per hog. (White-Iowa State)

### 0007 - A6, A7, B1, B2, C2

**SWINE WASTE MANAGEMENT - CASES FROM STORED SWINE WASTES,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AEng-879.

Descriptors: *Farm wastes, *Hogs, *Gases, Odors, Carbon dioxide, Ammonia, Hydrogen sulfide, Methane, Lagoons.
Identifiers: *Threshold limit values (TLV), Air quality, Irritation, Lethal situations, Storage pit, Concentrations, Asphyxiation, Symptoms.

This fact sheet concerns itself about the quality of the air inside confinement swine buildings with slotted floors since the wastes may be held in the building long enough to produce gases and odors. Noxious gases and odors formed from stored wastes can be irritating to both the hogs and operator and have been the cause of numerous complaints and even lawsuits by neighbors. The most important gases generated from stored manure, and those discussed by the fact sheet are carbon dioxide, ammonia, hydrogen sulfide, and methane. The potentially lethal situations of ventilation breakdown, agitation of storage pit, and entering a storage pit are discussed and warnings given. (White-Iowa State)

### 0008 - A6,B1,B2,C2,C3, D3

**AEROBIC TREATMENT OF LIVESTOCK WASTES,**
Illinois Univ., Urbana. Agricultural Experiment Station.
D. D. Jones, D. L. Day, and A. C. Dale.
University of Illinois Agricultural Experiment Station Bulletin 737, 1970. 55 p, 26 fig, 4 tab, 45 ref. HEW Grants EC-00245 and EC-00244.

Descriptors: *Oxidation lagoons, *Aeration, *Farm wastes, *Biochemical oxygen demand, Organic matter, Sludge disposal, Oxygenation, Hogs, Cattle.
Identifiers: *Oxidation ditch, *Aerobic lagoon, Livestock waste properties, Biochemical properties, Aerobic treatment, Irrigation system.

This report emphasizes the aerobic method of storage and treatment of livestock wastes primarily becuase of the low level of odors associated with aerobic treatment. An introduction to the theory of aerobic treatment is presented along with several laboratory experiments on swine, dairy cattle, and poultry wastes. These laboratory experiments verified the use of the aerobic method for livestock wastes. Two methods of aerobic treatment were studied and the results summarized. These were (A) the in-the-building oxidation ditch and (B) the aerobic lagoon (oxidation pond and aerated lagoon). Recommendations are made as to operator convenience, capacity, and design of the different systems. (White-Iowa State)

## 0009 - A6, B2, D3, E3

### LIVESTOCK WASTE MANAGEMENT STUDIES-TERMINATION REPORT,

Illinois Univ., Urbana. Agricultural Experiment Station.
D. L. Day, D. D. Jones, and J. C. Converse.
HEW Project No EC-245. July 1970. 97 p, 75 fig, 14 tab, 7 ref.

Descriptors: *Farm wastes, *Biochemical oxygen demand, *Chemical oxygen demand, *Odor, Hogs.
Identifiers: *Livestock oxidation ditch, Loading rates, Ditch mixed liquor, Optimum aerobic degradation, Aeration rotors, Operating cost, Feeding value of oxidation ditch solids.

This report deals mainly with results from laboratory tests and field trials of oxidation diches. Different loading rates were studied, and solutions to the problem of foaming were discussed. Most of the work was done with swine although laboratory tests were made with beef and dairy animals. Some research was done to determine the feeding value of oxidation ditch solids. The oxygenation capacity of rotors was discussed. A laboratory study of the minimum aeration for odor control was made using set design criteria. (White-Iowa State)

## 0010 - A2, B1, B5, C1, C2

### THE EFFECT OF ANIMAL DENSITY AND SURFACE SLOPE ON CHARACTERISTICS OF RUNOFF, SOLID WASTES AND NITRATE MOVEMENT ON UNPAVED BEEF FEEDLOTS,

Nebraska Univ., Lincoln. Agricultural Experiment Station.
C. B. Gilbertson, T. M. McCalla, J. R. Ellis, O. E. Cross, and W. R. Woods.
Publication SB508, June 1970. 23 p, 5 fig, 7 tab, 23 ref.

Descriptors: *Rainfall-runoff relationships, *Chemical analysis, *Farm wastes, Chemical oxygen demand, Biochemical oxygen demand, Cattle, Laboratory tests, Detention reservoirs, Nitrates, Phosphorus.
Identifiers: *Dry matter removed (DMR), *Dry matter feces (DMF), Volatile solids, Feedlot slope, Cattle densities, Soil core samples, Feedlots.

The objectives of this study were to determine the effect of feedlot slope and cattle densities on: (1) The quantity and quality of runoff resulting from rainstorms and snowmelt, (2) Downward movement of pollutants into the soil profile on unpaved feedlots, and, (3) Amount of solids accumulation on the feedlot surface. Pairs of feedlots with 3, 6, and 9% slopes were installed. Ten and twenty cattle were placed in each pair of feedlots, which allowed 200 and 100 sq. ft. of area per animal. Volumetric measurement of runoff resulting from rainfall and snowmelt were made and samples of each runoff occurrence were taken to the laboratory for analysis. Laboratory analyses included pH, electric conductivity, total solids, non-volatile solids, total nitrogen, ammonium, nitrate, total phosphorus, COD and BOD. Soil cores were taken to depths of 14 ft. below the feedlot surface and adjacent buffer strips to determine downward movement of contaminants into the soil profile. Solids accumulations on the lot surface were removed twice. Weights of material removed were recorded and composite samples were taken to the laboratory for analyses. (Christenbury-Iowa State)

## 0011 - A11, B1

### THE SEARCH FOR NEW POULTRY LITTER MATERIAL - AN EXAMPLE OF COOPERATION BETWEEN EXTENSION, RESEARCH AND INDUSTRY,

Georgia Univ., Athens. Dept. of Poultry Science.
Milton Y. Dendy, M. J. Reed, and M. G. McCartney.
Poultry Science, Vol 45, p 1666, 1968.

Descriptors: *Farm wastes, *Poultry, Physical properties, Performance, Agricultural engineering, Waste treatment, Pollutants.
Identifiers: *Litter materials, Pine bark, Pine bark and chips, Pine stump chips, Rice hulls, Poultry industry, Extension Poultrymen.

In the fall of 1966 a litter shortage was brought to the attention of the Extension Poultrymen during an industry meeting. The Extension Poultrymen took the problem to the research people in the Department of Poultry Science and the Department of Agricultural Engineering at the University of Georgia, and a project was started to test (1) the physical properties and performance characteristics of materials usable as litter in poultry houses, and (2) bird performance on several materials available in Georgia were tested, including pine shavings and pine sawdust, the two materials most commonly used. Results obtained indicate that some of the materials such as pine bark, pine bark and chips, pine stump chips and rice hulls are about as suitable for poultry litter as pine shavings or pine sawdust. (White-Iowa State)

## 0012 - A10, B1, E1

### CONTROL OF HOUSE FLIES IN SWINE-FINISHING UNITS BY IMPROVED METHODS OF WASTE DISPOSAL,

Purdue Univ., Lafayette, Ind. Dept. of Entomology.
R. C. Dobson, and F. W. Kutz.
Journal of Economic Entomology, Vol 63, No 1, February 1970. 6 fig, 3 ref.

Descriptors: *Farm wastes, *Hogs, Disposal, Lagoons, *Insect control, Vectors, Entomology.
Identifiers: *Control of house flies, *Waste disposal systems, Collection pit, Slotted floor.

Four swine-finishing units were equipped with different waste disposal systems to determine their effectiveness in preventing development of the house fly, Musca domestica L. Each unit was completely screened to prevent contamination from outside sources. No insecticides were used. One of the 4 was a standard shed-type house used as a control. The other 3 units were equipped with new and improved waste disposal systems. Results from 2 years of study indicate that house fly production in and around swine-finishing units can be greatly reduced by using 1 of the 3 improved methods of waste disposal described. (Miner-Iowa State)

## 0013 - A10, B1, B5

### INFLUENCE OF POULTRY-MANURE-REMOVAL SCHEDULES ON VARIOUS DIPTERA LARVAE AND SELECTED ANTHROPOD PREDATORS,

California Univ., Berkeley. Dept. of Entomology and Parasitology.
John H. Peck, and John R. Anderson.
Journal of Economic Entomology, Vol 63, No 1, February 1970, p 82-90. 11 fig, 7 ref.

Descriptors: *Farm wastes, *Poultry, *Larvae, *Insect control, *Entomology, Vectors.
Identifiers: *Manure removal, *Diptera larvae, *Arthropod predators, Sampling, Control of flies.

The effects of weekly manure removal, monthly removal, and no removal on populations of fly larvae and slected predators (Acarina: Machrocheles muscaedomesticae Scopoli, Fuscuropods sp. (undescribed), Parasitidae; Coleoptera: Staphylinidae, Histeridaw, Hydrophilidae; Diptera: Ophyra leucostoma (Wiedemann) were studied for a full fly season at each of 2 northern California ranches. Third-instar larvae of the house fly, Musca domestica L., the false stable fly, Muscina stabulans (Fallen), and Calliphoridae were most abundant in 1-week-old manure; those of the little house fly, Fannia canicularis (L.), the coastal fly, Fannia femoralis Stein, and the black garbage fly, O. leucostoma, reached greatest numbers in 2- to 3-week-old manure. Unremoved manure had the least numbers of dipterous larvae, with the exception of the stable fly, Stomoxys calcitrans (L.). All predators studied were most abundant in unremoved manure. Abstention from manure removal favored the predators; monthly or biweekly removal favored the dipterous larvae. (Miner-Iowa State)

## 0014 - A11, B1, B5

### INFLUENCE OF SPACE ON PERFORMANCE OF FEEDLOT CATTLE,

California Univ., Davis; and Agricultural Research Service, Davis, Calif.
S. R. Morrison, V. E. Mendel, and T. E. Bond.
Transactions of the ASAE, Vol 13, No 1, January 1970, p 145-147. 2 fig, 2 tab, 9 ref.

Descriptors: *Farm wastes, *Cattle, *Performance, *Confinement pens.
Identifiers: *Space, *Influence, *Weight gain, Feed efficiency.

Two tests in the Imperial Valley of California involving 74 heifers indicate that space allotments below 40 sq. ft. per head are likely to reduce the body weight gains and feed efficiency of feedlot cattle, and hot weather may accentuate the decrease. There is evidence suggesting that animal performance may be less even at 40 sq. ft. than at 60 sq. ft. per head. Tests with larger pens and more animals are desirable to establish the relation between gain and feed efficiency and pen space per animal. The range of space tested should be great enough to provide sufficient data to aid in designing feed lots for maximum profit. (White-Iowa State)

## 0015 - B1, B2, E2

### CATTLE FEEDERS AVOID POLLUTION BY USING WASTES IN IRRIGATION.

Soil Conservation Service, Washington, D.C.

Soil Conservation, Vol 34, No 4, November 1968, p 84-86. 3 fig.

Descriptors: *Farm wastes, *Cattle, *Ponds, *Furrow irrigation, Lagoon, Water pollution, Nebraska, Water Quality Act, Costs, Loess.
Identifiers: *Tractor driven pump, Soil Conservation Service, Feedlots.

Two brothers in Franklin county Nebraska have implemented a system that avoids pollution while fertilizing and irrigating their land. Solid wastes are hauled to the field from their 5 feedlots covering four acres. The rest washes down with every rain and is caught in a farm pond in a natural draw. In the bottom of the pond a lagoon-type pit was dug so there will always be some water available to keep wastes in suspension. From here the suspension is pumped to nearby fields by a tractor driven pump. If it doesn't rain they pump water from their irrigation wall into the pond and out again onto the land. (White-Iowa State)

### 0016 - A5, A8, E2

**FERTILIZERS AND FEEDLOTS — WHAT ROLE IN GROUNDWATER POLLUTION.**

Agricultural Research, Vol 18, No 6, December 1969, p 14-15.

Descriptors: *Farm wastes, *Soil contamination, *Fertilizers, *Nitrates, Water pollution, Nitrogen, Nitrites, Aquifers, Colorado, Denitrification, Water table, Percolation.
Identifiers: *Feedlots, South Platte River Valley.

No significant contamination of the water table with nitrate from farm fertilizers or extensive cattle feeding operations was found in preliminary ARS studies in northeastern Colorado. But studies indicated that substantial amounts of nitrate could eventually reach the water table under heavily fertilized irrigated fields and under feedlots. ARS soil scientists measured nitrates in 129 soil cores drilled to bedrock or the water table and in 75 samples of groundwater taken with the cores in Colorado's South Platte River Valley. The investigators found that, on the average, the kind of land use did not effect the nitrate concentration of water entering the bottom of the holes where the cores were taken. The surface may contain more pollutants than water deeper in the aquifer. (White-Iowa State)

### 0017 - A6, D1, D2, F6

**AN IMPROVED METHOD FOR PREPARATION OF FECES FOR BOMB CALORIMETRY,**
School of Aerospace Medicine, Brooks AFB, Tex.
Hubert G. Lovelady, and Emmett J. Stork.
Clinical Chemistry, Vol 16, No 3, 1970, p 253-254. 1 tab, 2 ref.

Descriptors: *Laboratory tests, Energy, Odor, *Farm wastes, Drying.
Identifiers: *Bomb calorimetry, Lyophilize.

As a preliminary to bomb calorimetry, weighed, homogenized fecal slurries are prefrozen and lyophilized. Advantages of this method over the method of drying in a vacuum oven include: more moisture is removed from the sample initially, drying time is reduced from 48h to 16 h, grinding is eliminated and objectionable odors are eliminated during sample processing. (Christenbury-Iowa State)

### 0018 - A10, A11, A12, B1, C3

**SALMONELLA Spp. AND SEROTYPES OF ESCHERICHIA COLI ISOLATED FROM THE LESSER MEALWORM COLLECTED IN POULTRY BROODER HOUSES,**
Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.
Philip K. Harein, Ernesto De LasCasa, B. S. Pomeroy, and Mabel D. York.
Journal of Economic Entomology, Vol 63, No 1, February 1970, p 80-82. 3 tab, 20 ref.

Descriptors: *Farm wastes, *Poultry, *Salmonella, *E. coli, Cultures.
Identifiers: *Isolated, *Brooder houses, Litter, Mealworms, Pathogens.

Adult Alphitobius diaperinus (Panzer) were collected from the litter of poultry brooder houses in 1967 and 1968. One thousand of the lesser mealworms were individually surface disinfected, mascerated, and cultured in thioglycolate enrichment broth at 37 degrees C and streaked on eosin methylene blue agar or brilliant green agar plates for detection of Escherichia coli (Migula) Castelani and Chalmers and Salmonella spp., respectively. Five species of Salmonella found within the lesser mealworms were identified as S. heidelberg Kauffman, S. worthington Edwards and Bruner, S. saint paul Kauffman, S. typhimurium var copenhagen Kauffman, and S. chester Kauffman and Tesdal. Forty-eight serotypes of E. coli were recovered from within 251 lesser mealworms. Twenty-six of these serotypes are known pathogens for man or animals. (Miner-Iowa State)

### 0019 - A6, A8, D2, E2, F3

**CONTROL OF ODORS FROM ANIMAL WASTES,**
W. E. Burnett, and N. C. Dondero.
Transaction of the ASAE, Vol 13, No 2, p 221-224, 231, March 1970. 3 fig, 5 tab, 15 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, *Chemicals, Costs.
Identifiers: *Odor panel, *Masking agents, *Counteractants, Deodorants, Digestive deodorants, D-indices.

A matching-standard method was successfully used for the evaluation of the ability of commercial odor-control chemicals to mask or eliminate the offensive odor of poultry manure when added directly to the waste in both loboratory and field tests. The method enables one to find the most effective chemicals in a systematic and relatively time-saving manner. The method provides information on the lowest concentration of chemical necessary to obtain a desired effect. Masking agents and counteractants were found to be the most effective odor-control products, deodorants were moderately effective, and digestive deodorants were least effective. The cost in some field trials was estimated to be 63 cents per 450 gal. of liquid manure. Further research is needed on the effect of repeated applications of odor-control products on soil, so as not to harm the soil for other purposes. (White-Iowa State)

### 0020 - A11, E2

**EFFECT OF DIETS CONTAINING DEHYDRATED POULTRY WASTE ON QUALITY CHANGES IN SHELL EGGS DURING STORAGE,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
L. R. York, C. J. Flegal, H. C. Zindel, and T. H. Coleman.
Poultry Science, Vol 49, No 2, p 590-591, March 1970. 1 tab, 3 ref.

Descriptors: *Farm wastes, *Poultry, *Dehydration, *Diets, Eggs.
Identifiers: *Haugh unit, *Qaulity changes, Color and odor observations, Waste feeding, Manure utilization, Dried poultry wastes.

Eggs from 32 Leghorn-type hens on each of four diets were used. All the birds were 10 months of age and had been on the experimental diet for three months. The diets used were (1) control, (2) control with 10% DPW, (3) control with 20% DPW, and (4) control with 30% DPW. One-day-old eggs were stored at room environment to accelerate the changes that occur during storage. Room temperature varied from 22 degrees C to 25 degrees C and relative humidity varied from 50% to 68%. Eggs were gathered on five consecutive days and held for storage periods of 10, 20, 30, 40 or 50 days. Physical and microbiological examinations were made at the beginning of the trial and at the end of the designated storage periods. The results of this experiment indicate that including 10, 20, or 30% dehydrated poultry waste in the diet of hens had no significant deleterious effect on the quality of shell eggs as measured by Haugh units, storage weight loss, color, odor, and/or microbial content. (Miner-Iowa State)

### 0021 - A8, E2

**EFFECT OF MANURE APPLICATION, AERATION, AND SOIL pH ON SOIL NITROGEN TRANSFORMATIONS AND ON CERTAIN SOIL TEST VALUES,**
Wisconsin Univ., Madison. Dept. of Soils.
R. J. Olsen, R. F. Hensler, and O. J. Attoe.
Soil Science Society of America Proceedings, Vol 34, No 2, p 222-225, March-April 1970. 2 fig, 2 tab, 10 ref.

Descriptors: *Nitrification, *Denitrification, *Farm wastes, *Aeration, Soil tests, Rates of application.
Identifiers: N recovery, Field moisture capacity, *Soil nitrogen transformations, Soil pH, Nitrate production.

Nitrate production under aerobic conditions was directly related to rate of manure application, period of incubation and soil pH, but was stopped under anaerobic conditions. Average recovery by chemical analysis of N applied as manure to a Plainfield sand at relatively high rates and incubated for 37 weeks was 77% for aerobic conditions and 24% for anaerobic conditions. The addition of manure tended to increase soil pH and the contents of organic N, available P and exchangeable K, Ca, and Mg, particularly at the higher rates. They also increased the field moisture capacity of a Plainfield sand. However, on an acid Ella loamy sand the two highest rates of manure caused a reduction of the values for field moisture capacity, apparently the result of formation of a waxy material that tended to repel water absorption. (Miner-Iowa State)

### 0022 - A6, B2, D1, D3

**SIMPLE SYSTEM FOR AERATING MANURE LAGOONS,**
DeKalb AgResearch, Inc., Ill.
Jay Gilliland.
Poultry Digest, Vol 29, p 330-331, July 1970. 1 fig.

Descriptors: *Farm wastes, *Poultry, *Sedimentaitation, *Aeration, Anaerobic conditions, Aerobic conditions, Odors, Sulfides, Methane, Construction costs, Operation and maintenance, Cost analysis, Erosion, Waste water treatment.

An aerated lagoon system was designed to treat the 1780 cu. yds of manure produced annually by two 30,000-hen automatic environmental controlled laying houses, instead of relying on spreading the manure on the land. A 100 ft by 200 ft lagoon with a12 ft. depth and a two-to-one side slope was constructed at a cost of $900, having an estimated 10 year life. A six nozzle irrigation sprinkler run by a centrifugal irrigation pump with a 5 hp motor provides aeration at a cost of $2.20 per day. Water is drawn from just below the surface and sprayed into the air in order to reduce odors. The methane and hydrogen sulfide gases generated by anaerobic action on the lagoon bottom are dissipated by aerobic bacteria near the top and their odor eliminated. This method has been demonstrated to be a low costs disposal, low cost upkeep system particularly suited for this job. (Lowry-Texas)

### 0023 - A10, F6

**ATTRACTION OF COPROPHAGOUS BEETLES TO FECES OF VARIOUS ANIMALS,**
Georgia Coastal Plain Experiment Station, Tifton.
G. Truman Fincher, T. Bonner Stewart, and Robert Davis.
The Journal of Parasitology, Vol 56, No 2, April 1970, p 378-383. 2 tab, 20 ref.

Descriptors: *Farm wastes, *Insects, *Habitats, Animal, Intermediate hosts.
Identifiers: *Beetle species, Pit traps, Feces, Woodland habitat, Swine pasture, Dairy pasture.

Beetles were attracted to pit traps baited with the feces of one of 12 different animals in 3 habitats

Comparison of the 3 habitats showed marked differences in beetle fauna. Most dung beetles were captured in traps baited with swine feces. Swine and opossum feces attracted 57.7% of all beetles captured and 74.8% of the Phanaeus species which are the major intermediate hosts of swine spirurids in southern Georgia. Captured beetles comprised 12 genera with more than 18 species. (White-Iowa State)

### 0024 - A10, A11, F6

**PROBABLE SOURCES OF SALMONELLAE ON A POULTRY FARM,**
Punjab Agricultural Univ., Hissar (India). Dept. of Veterinary Bacteriology and Hygiene.
S. M. Goyal, and I. P. Singh.
British Veterinary Journal, Vol 126, No 4, p 180-184, 1970. 2 tab, 17 ref.

Descriptors: *Farm wastes, *Salmonella, *Poultry, *Farm, Domestic animals, Rodents, Reptiles.
Identifiers: Salmonellosis, Transmission, Cross-infection.

This study was undertaken to determine various sources of Salmonellae on a poultry farm. Pigs, sheep, and other domestic animals were checked, as well as rats, sparrows, birds, and wall lizards. Eight Salmonellae types were isolated from poultry, pigs, rats, wall lizards, and house sparrows. S. anatum was isolated from all these sources and S. stanley from rats and poultry, indicating the possibility of cross-infection due to multiple foci of Salmonella infections. Rodents, free-flying birds and lizards were considered as important sources of Salmonellae. (White-Iowa State)

### 0025 - A7, A11, B1

**BACTERIAL CONTAMINATION IN POULTRY HOUSES AND ITS RELATIONSHIP TO EGG HATCHABILITY,**
Pennsylvania Univ., University Park. Dept. of Poultry Science.
C. L. Quarles, R. F. Gentry, and G. O. Bressler.
Poultry Science, Vol 49, No 1, p 60-66, 1970. 8 tab, 15 ref.

Descriptors: *Farm wastes, *Bacteria, *Poultry, *Fertility, Eggs.
Identifiers: *Egg contamination, Egg hatchability, Air sampler, Litter houses, Litter nests, Wire floors, Roll-away nest.

This study was designed to determine if there was any relationship among poultry house contamination, egg contamination and hatchability. A high density sloping wire floor system was compared with the conventional litter floor system. Rates of egg production and fertility were similar in both systems. Litter houses averaged 9 times as many bacteria per cubic foot of air as wire floor houses. An attempt was made to study the level and transmission of coliform type bacteria as related to type of house and nest used. Hatchability of eggs in wire flood pens was superior to eggs from litter floor pens. Fungal contamination of air was approximately the same for both systems. (White-Iowa State)

### 0026 - A12, F6

**A RAPID AND SIMPLE METHOD FOR THE DETECTION AND ISOLATION OF SALMONELLA FROM MIXED CULTURES AND POULTRY PRODUCTS,**
Iowa State Univ., Ames. Dept. of Food Technology.
Daniel Y. C. Fung, and Allen A. Kraft.
Poultry Science, Vol 49, No 1, p 46-54, 1970. 1 fig, 7 tab, 7 ref.

Descriptors: *Isolation, *Salmonella, *Poultry, *Cultures, Farm wastes.
Identifiers: Poultry products, Motility flask, Concentrations, Strains.

This report deals with results obtained using a new rapid method of Salmonellae detection and isolation in mixed cultures, turkey and chicken products, and whole eggs. The paper describes a simple system, combining biochemical and physical properties of Salmonella, which can detect small numbers of Salmonella in the presence of large numbers of competitive organisms. Motility multilayered agar flasks were used in the test. Typical complete Salmonella reactions were obtained in the control flask as early as 17-36 hours of incubation, as compared with 48-96 hours by conventional methods. This system has the potential as a simple and rapid method for large scale screening test for Salmonellae in a variety of commercial food products. (White-Iowa State Univ)

### 0027 - A11, B1, C2, F6

**EFFECT OF STRESS ON SWINE: HEAT AND COLD EXPOSURE AND STARVATION ON VANILMANDELIC ACID OUTPUT IN THE URINE,**
Guelph Univ. (Ontario). Dept. of Nutrition.
M. P. Stefanovic, H. S. Bayley, and S. J. Slinger.
Journal of Animal Science, Vol 30, No 3, p 378-381, 1970. 1 fig, 2 tab, 12 ref.

Descriptors: *Hogs, Air temperature, *Urine, Amino acids, *Farm wastes.
Identifiers: Vanilmandelic acid output, Starvation, Metabolic response.

Tests were performed on 3 Yorkshire pigs in which they were subjected to normal conditions, extreme temperatures of 5 and 33C, and finally starved for 10 days at 20C. The urinary excretion of 3-methoxy - 4-hydroxymandelic acid (VMA) was measured when the pigs were housed in cages maintained at a room temperature of 20C. Observations of the VMA content was also made at times the pigs were under the stress conditions. The pigs increased in weight from 8 to 30 kg. during the 70 day experiment. Under normal temperature they excreted 10 mg of VMA per 24 hours. This increased to between 20 and 30 mg when the pigs were exposed to the low temperature. Exposure to the high temperature resulted in an excretion of 20 mg per day, but starvation caused a rapid decline to 3 mg per day. The excretion returned to normal values very rapidly when the animals were refed. These observations are discussed in relation to those made by other authors with other species on the effects of stress on the release and metabolism of catecholamines and their excretion in the urine, and it is suggested that the urinary output of VMA offers a convenient method of measuring physiological response to stress in the pigs. (White-Iowa State)

### 0028 - B5, C1, D3, E4, F6

**HOUSEFLY LARVAE: BIODEGRADATION OF HEN EXCRETA TO USEFUL PRODUCTS,**
Agricultural Research Service, Beltsville, Md.
C. C. Calvert, N. O. Morgan, and R. D. Martin.
Poultry Science, Vol 49, No 2, p 588-590, March 1970. 2 tab, 3 ref.

Descriptors: *Farm wastes, *Livestock, *Manure, *Poultry, Insects, Waste treatment, Ultimate disposal, Waste disposal, Odor.
Identifiers: House fly, Hen, Fly eggs, Manure treatment, Waste utilization.

This report presents the results of experiments to establish the concentration of fly eggs that can be used to process hen excreta most efficiently, and a means of separating the house fly pupae from the processed hen excreta and to simplify their collection. Within four days after seeding with house fly pupae the odor of the manure became unobjectionable. After eight days the excreta was reduced to an essentially odorless and friable material. The separated pupae were utilized as a protein source in the diet of growing chicks. (Miner-Iowa State)

### 0029 - A11, E3

**DRIED POULTRY MANURE AS CATTLE FEED,**
NAAS, Cambridge.
C. B. Fairbairn.
Poultry Digest, July 1970. p 331, Vol. 29, No. 341.

Descriptors: *Farm waste, *manure, *poultry, drying.
Identifiers: Manure feeding, poultry manure, nutritional value.

Presents data on the nutritional value of dried poultry manure with and without litter. The energy value for dried litter is 500 calories per pound which is about one third that for grain. Protein value was similar to cereal. It was shown to be suitable for inclusion in intensive beef rations. (Miner-Iowa State)

### 0030 - B2, B4, C2, D3, E2

**TREATMENT OF DAIRY MANURE BY LAGOONING,**
Washington State Univ., Pullman.
Surinder K. Bhagat, and Donald E. Proctor.
Journal Water Pollution Control Federation, Vol 41, No 5, 1969, p 785-795. 9 fig, 7 tab, 6 ref.

Descriptors: *Farm wastes, *Farm lagoons, *Biodegradation, Algae, Biochemical oxygen demand, Anaerobic digestion, Aerobic treatment, Chemical oxygen demand, Storage capacity, Effluents, Construction.
Identifiers: *Dairy manure, Total solids, Volitile solids, Non-degradable solid.

Because of high solids content of dairy manure waste, anaerobic lagoons can be used satisfactorily as a primary waste treatment. Average removals of BOD, COD, TS, and VS above 86 percent can be accomplished with an applied loading of 70 lb VS/day/1000 Cu. Ft. (1120 g/day/cu. m.). An anaerobic lagoon can act as a sedimentation, flotation, and anaerobic digestion process unit while simultaneously providing long-term storage for non-degradable solid residue. The effluent from the anaerobic lagoon retains most of the nutrients present in the raw manure waste and thus has fertilizer value. The effluent has organic matter which can be oxidized. The effluent can be applied to a field or subjected to further treatment. The secondary treatment can be an aerated lagoon, oxidation ditch, or an oxidation pond. The results of the batch type aerobic treatment indicated that an effluent BOD at 20 mg/l can be achieved by a 24-hr. aeration period. (Christenbury-Iowa State)

### 0031 - A4, A5, B5, C2

**VOLATILIZATION AND NITRIFICATION OF NITROGEN FROM URINE UNDER SIMULATED CATTLE FEED LOT CONDITIONS,**
Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
B. A. Stewart.
Environmental Science and Technology, Vol 5, No 7, p 579-582, July 1970. 1 fig, 7 tab, 7 ref.

Descriptors: *Nitrification, *Cattle, *Soils, Ammonia, Nitrogen Moisture content, Depth, Chemical oxygen demand, Farm wastes, Urine.
Identifiers: *Feed lots.

Virtually all the recent growth in cattle feeding has been in feeding units of 10,000 head or more in which cattle are confined in pens allowing 6 to 20 sq meters per animal. Animal wastes resulting from these large feeding operations cause concern in many areas. Disposal of the accumulation of solids wastes is difficult and in some cases run-off from these lots has caused pollution of streams and lakes. Feeding operations can cause high nitrogen concentrations in the underground water supply. There are large differences in the amount of nitrate found under feed lots: some contain large amounts, other nearly nitrate free, both at shallow and deep depth. The objectives were to simulate some feed lot conditions and study the nitrification and volatilization weights of nitrogen added as cattle urine to soil in an attempt to determine some of the factors governing nitrate accumulation under feed lots. Urine accounts for about half of the nitrogen excreted by cattle. When urine was added every two days to an initial wet soil at a rate of 5 ml per 21 cm sq, less than 25% of the nitrogen was lost as ammonia and about 65% converted to nitrate. When urine was added every 4 days to initially dry soil, essentially all the water evaporated between the urine additions, and 90% of the nitrogen was lost as ammonia. These findings suggest that the stocking rate and other management factors should be considered in pollution of the unit. (Hancuff-Texas)

### 0032 - A4, A6

**NATURAL FILTERS FOR AGRICULTURAL WASTES,**
Soil Conservation Service, Washington, D.C.
W. E. Bullard, Jr.
Soil Conservation, Vol 34, No 4, November 1968, p 75-77. 2 fig.

Descriptors: *Farm wastes, *Sprinkler irrigation, *Organic wastes, *Waste water disposal, Air pollution, Water pollution, Odor, Effluents, Sewage effluents, Dilution, Decomposing organic matter, Insects, Mites, Bacteria, Fungi, Algae, Nitrites, Nitrates, Detergents, Phosphates.
Identifiers: *Biologic 'disposers', Microscopic organisms, Papermill waste effluent, Cheese factory waste waters.

Farmers and processors of farm products are finding that the waste products of their operations generally can be returned to the land with less hazard to the environment than when discharged into streams. By completing the natural cycle of growth, death, and decay on the land where crops are produced they make use of a legion of 'disposer' organisms in the soil capable of decomposing organic wastes on site. When sprayed on grass or crops, the effluent serves the dual purpose of irrigating and fertilizing the field, thus, agriculture has the potential means of disposing of its own wastes and preventing or reducing environmental pollution. Numerous examples are given of returning sewage treatment effluents, pulp and papermill effluents, and cheese factory waste waters, among others, to the land by sprinkler irrigation. The principle behind these successful operations is that of getting material produced from the land back onto the land where they can be used again in production. (White-Iowa State)

### 0033 - B2, C2, E2

**IRRIGATING WITH ANIMAL WASTE,**
Soil Conservation Service, Hermiston, Oreg.
Clarence Underwood.
Soil Conservation, Vol 34, No 4, November 1968, p 81-82. 3 fig.

Descriptors: *Farm wastes, *Hogs, *Irrigation, *Sewage disposal, Effluent, Soil conservation, Odor, Fertilization, Lagoons, Sprinkler irrigation, Nitrogen, Waste dilution, Water pollution.
Identifiers: *Soil Conservation Service, Velocity-controlled water outlets, Holding basin.

Two brothers purchased a civilian housing facility from the Umatilla Army Depot and converted the 57 units to hog production. Wastes from the 22,000 hog per year facility are flushed into a gutter, through a sewer system and into the first of two lagoons. A second holding basin allows additional settlement and dilution of solids. From here it is pumped to irrigate about 500 acres of land. The brothers estimate that their system puts about 5 pounds of nitrogen per acre on a field each time it is irrigated. The crops are fertilized, little odor is noticeable, and no water pollution has been detected. (White-Iowa State)

### 0034 - C2, D2, F6

**A RAPID EXTRACTION AND QUANTIFICATION OF TOTAL LIPIDS AND LIPID FRACTIONS IN BLOOD AND FECES,**
Pittsburgh Univ., Pa. Dept. of Pathology.
J. S. Amenta.
Clinical Chemistry, Vol 16, No 4, 1970, p 339-346. 8 fig, 19 ref, 1 tab.

Descriptors: *Lipids, *Laboratory tests, Chemical analysis, Farm wastes.
Identifiers: *Feces, Plasma, Lipid fractions, Clinical laboratory, Cholesterol.

An analytical system for plasma lipids suitable for use in the large and small clinical laboratory is presented. Lipids are extracted into a chloroform-methanol solvent and concentrated into a chloroform phase by a wash with an aqueous CaCl2 solution. This extract is used to estimate total lipids and (after separation by thin-layer chromatography) the major lipid factions. A single acid dichromate reagent is used for all quantification of fecal lipids. Lipids in other body fluids can be conveniently analyzed with this flexible method. (Christenbury-Iowa State)

### 0035 - A6, A13, B2, C1, C2, D1, D2, D3, E3

**TREATMENT OF BEEF-CATTLE WASTE WATER FOR POSSIBLE REUSE,**
North Dakota State Univ., Fargo.
G. L. Pratt, R. E. Harkness, R. G. Butler, J. L. Parsons, and M. L. Buchanan.
Transactions of the ASAE, Vol 12, No 4, 1969, p 471-473. 2 fig, 3 tab, 19 ref.

Descriptors: *Farm wastes, *Cattle, *Septic tank, Biochemical oxygen demand, Chemical oxygen demand, Hydrogen ion concentration, Effluents, Aeration, Dissolved oxygen, Turbidity, Aluminum.
Identifiers: *Settling tank, *Slatted floor, *Reuse, Total solids, Volatile solids, Aluminum sulfate.

Removing solid materials from wastes that have been washed from a livestock barn with water can be accomplished in several ways. In trials at the North Dakota Agricultural Experiment Station settling tanks were evaluated. Treatments of overflow from the settling tank by aeration and chemical coagulation were compared with settling only. The equipment consisted of an 8x8 foot animal shelter with a steel-slatted floor. Manure was washed from under the floor to a settling tank. A secondary treatment tank was installed to receive overflow from the settling tank. A pump and holding tank was used so that the effluent from the secondary treatment tank could be used in washing the floor under the steel slats. Aeration and treatment with alum did not upgrade the waste water sufficiently to make the water odorfree. It was also colored. Other treatment will be needed to remove the odor before the water can be suitable for reuse in washing the building. (White-Iowa State)

### 0036 - A11, B3, C3, F6

**OBSERVATIONS ON THE EFFECT OF THE RE-USE OF BROILER LITTER ON THE INCIDENCE OF MAREK'S DISEASE,**
Delaware Univ., Newark.
G. W. Chaloupka, R. W. Lloyd, J. F. Gordy, and L. M. Greene.
Poultry Science, Vol 47, p 1660, 1968.

Descriptors: *Farm wastes, *Condemnation, *Poultry, *Disinfection, Public health, Pollution abatement, *Diseases.
Identifiers: *Marek's disease, Broiler house, Litter re-use, Leucosis, Immunity, Causative agent.

Four different studies involving several trials have been conducted at the University of Delaware Substation in which the performance of broilers grown on re-used litter was compared to those grown on new litter. These studies over a period of several years have shown that broiler condemnations due to leucosis have in most instances been lower for the broilers grown on re-used litter. This substantiates the findings of many field studies and by at least one private research farm. These results would indicate that a failure to clean out and disinfect the broiler house before placing each new lot of chicks is not a primary factor in increasing the incidence of Marek's disease. It is not known whether these results are due to developing a partial immunity due to contact with the causative agent in the litter at an early age, or whether the causative agent is destroyed in some way in the reused litter. (White-Iowa State)

### 0037 - A4, B1, F2

**WATER POLLUTION CONTROL LEGISLATION,**
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
Condensation of report NA68-304 available from ASRE, St. Joseph, Mich. 49085, $0.50. Agricultural Engineering, Vol 50, August 1969, p 468-470. 8 ref.
Descriptors: *Farm wastes, *Water pollution, *Legislation, Water pollution control, Water Quality Act, Biochemical oxygen demand, Phosphates, Effluents.
Identifiers: *Treatment processes, Aerobic oxidation pond, Aerated lagoon, Oxidation ditch, Minimum removal efficiencies, Water quality criteria.

Agricultural production facilities must consider waste disposal as an important aspect of their operations. Waste treatment and disposal facilities are becoming important parts of agricultural production facilities. They must be evaluated whenever expansion or establishment of new facilities is underway. Highly efficient secondary treatment processes perhaps including nutrient removal and disinfection may be necessary for discharging waste waters to surface waters. The need for and cost of these processes should cause a re-evaluation of the comparative costs of handling, treatment, and disposal of agricultural wastes as a solid. Land disposal is another alternative. When agricultural wastes are handled to avoid polluting surface waters, other types of pollution must be avoided. Mere transferral of pollution from one sphere to another will no longer be tolerated. These are among the aspects which this paper deals with. (White-Iowa State)

### 0038 - A2, A4, B2, B3, E2, F2

**PONDS STOP POLLUTION FROM FEEDLOTS,**
Soil Conservation Service, Salina, Kans.
George R. Smith, and F. DeWitt Abbott.
Soil Conservation, Vol 34, No 4, Nov 1968, p 78-79. 2 fig.

Descriptors: *Farm wastes, *Water Quality Act, Ponds, Kansas, Water pollution, Dams, Runoff, Soil, Sprinkler irrigation.
Identifiers: *Feedlots, Soil Conservation Service, Detention ponds, Kansas State Department of Health, Solid waste, Liquid waste.

In compliance with the Federal Water Quality Act of 1965 and a 1967 Kansas State law a northwest Kansas feedlot is retaining and disposing of animal wastes in a non-pollutional manner. The 14,000 head beef feedlots is located at the headwaters of a subdrainage area of Hackberry Creek. The feedlot, covering 100 acres, drains into two intermittent natural draws. Each draw has a pair of detention ponds. One collects solid wastes, and below this a second pond holds drainage from the first pond. Pipes with slide gates provide controlled drainage of liquids from the solid-waste ponds into the liquid waste ponds. The dams were built to state health department standards to contain 3 inches of runoff from the feedlot. The excess water from the lower ponds will be used for irrigation. The ponds are flat bottomed to facilitate removal of solid wastes. (White-Iowa State)

## 0039 - B2, D1, D3, E2, F1

**LABOR-FREE MANURE DISPOSAL,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
Rex Wilmore.
Farm Journal, Vol 93, No 8, August 1969, p 26C-26D. 1 fig.

Descriptors: *Farm wastes, *Aeration, *Lagoons, Aerobic bacteria, Effluent, Sprinkler irrigation, Storage capacity, Water pollution, Odors, Efficiencies, Slurries, Oxygen, Organic matter, Pumps, Labor, Costs, Management.
Identifiers: *Floating aerator, Suspended solids, Volatile solids.

Research at Purdue University indicates that a floating aerator in a lagoon can provide a low cost system that promises to avoid pollution dangers and saves labor. Manure is dumped into the lagoon once each day although it is better to have it continuously trickle in. Extra water is added to bring the solids content down to 2% or 3% for top efficiency. The aerator, a big doughnut-like float with an electric motor on top driving an impeller, runs continuously. The impeller forces a spray of slurry up over the float, mixing air into the lagoon, so aerobic bacteria can break down manure without odors. Periodically a small pump pulls out some of the mixed slurry and sprinkles it through a 'big gun' type nozzle onto grassland. The irrigation lowers the lagoon, which allows more water dilution and removes the suspended solids that won't decompose. Other advantages include low labor cost as compared to pits and spreaders, and minimal management. Its biggest disadvantage might be getting the manure into the lagoon each day. (White-Iowa State)

## 0040 - A11, C1, C3, F6

**PHYSICAL AND BIOLOGICAL EVALUATION OF FIVE LITTER MATERIALS,**
Purdue Univ., Lafayette, Ind. Dept. of Animal Sciences.
Paul L. Ruszler, and James R. Carson.
Poultry Science, Vol 47, p 1712, 1969.

Descriptors: *Farm waste, *Poultry, *Absorption, Moisture, Particle size, Laboratory tests, Waste water treatment, Waste treatment, Water pollution effects.
Identifiers: *Litter materials, Field conditions, Peanut shells, Pine bark, Ground cobs, Wood shavings, Cane pomace.

The usefulness of peanut shells, pine bark, ground cobs, wood shavings and cane pomace as litter materials in rooster production was evaluated under laboratory and field conditions on the basis of their physical properties and effects on the birds during a 14-week growing period. When the amount and rate of moisture exchange was compared, it was found that all five materials differed significantly. When ranked by grams of moisture absorbed per gram of dry weight, cane was highest, followed by shavings, cobs, shell, and bark. The materials with the smaller particle sizes absorbed less total moisture in both growing house and laboratory tests. The same materials rated low in breast blister incidence, but without statistical significance. (White-Iowa State)

## 0041 - A8, C1, E2, F6

**THE EFFECTS OF FARMYARD MANURE ON MATRIC SUCTIONS PREVAILING IN A SANDY LOAM SOIL,**
National Vegetable Research Station, Wellesbourne (England).
P. J. Salter, G. Berry, and J. B. Williams.
Journal of Soil Science, Vol 18, No 2, 1967, p 318-328. 3 fig, 2 tab, 25 ref.

Descriptors: *Farm wastes, *Soils, *Soil moisture, Field capacity, Wilting point, Equations.
Identifiers: *Soil matric suctions, Ryegrass, Available-water capacity, Moisture characteristic.

Soil matric suctions under a crop of ryegrass on farmyard manure-treated and untreated plots were determined over a total period of 24 weeks from March to November. The soil moisture characteristic of each plot was determined five times throughout this period, and for each plot and on every occasion a linear relationship was found between moisture content and log matric suction. A formula was derived to account for the seasonal changes in moisture characteristic - and it was then possible to obtain matric suction values from the soil moisture contents obtained from twice-weekly sampling of each plot. Although differences between available-water capacity of the manured and unmanured plots were small throughout the 6-month period of sampling, the soil matric suctions of the manured plots were almost always lower than those of the unmanured plots. The lower suctions prevailing in the manured soil could be a factor contributing to the higher yields of ryegrass obtained from the manured plots as compared with those obtained from the unmanured plots. (White-Iowa State)

## 0042 - A3, A4, C2, E2

**STREAM ENRICHMENT FROM FARM OPERATIONS,**
Wisconsin Univ., Madison.
Neal E. Minshall, Stanley A. Witzel, and Merle S. Nichols.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA2, April 1970, p 513-524. 2 fig, 5 tab, 4 ref.

Descriptors: *Farm wastes, *Fertilizers, *Runoff, Nitrogen, Phosphorus, Potash, Wisconsin, Water pollution, Nutrients, Precipitation, Rates of application, Corn, Frozen ground.
Identifiers: *Nutrient losses, Collection tanks.

In order to obtain information on the amount of fertilizer materials lost in runoff water from farm lands under cultivation, eight plots, 10x40 ft. in size, were established on the University of Wisconsin Agricultural Experiment Station Farm near Lancaster, Wisconsin. Investigations involving fertilizer and manure applications and losses in surface runoff were begun in 1966 and were continued through 1969. Each plot was completely surrounded by a galvanized metal border which prevented surface runoff from entering or leaving the plots, located on a 10% to 12% slope. Runoff was collected in a trough at the lower end and funneled to a measuring tank. Manure was applied at the rate of 15 tons per acre in the winter and spring. Later corn was planted in 30 inch rows on the contour. Up to 20% of N, 13% of P, and 33% of K nutrients in winter applied manure, on frozen ground, may be lost under conditions favoring maximum early spring runoff. Nutrient losses in surface runoff from plots having manure applied in the summer and incorporated into the soil were less than from check plots, which received no manure. (White-Iowa State)

## 0043 - A9, A11, D2, E3

**FUMIGATION AND REUSE OF BROILER LITTER,**
Hawaii Univ., Honolulu. Dept. of Animal Sciences.
Ernest Ross.
Poultry Science, Vol 47, 1968, p 1711-1712.

Descriptors: *Farm wastes, *Poultry, *Fumigants, Broods, Performance, Mortality, *Waste treatment.
Identifiers: Weight gains, Feed conversion, Reused litter, Litter, Methyl bromide.

A series of experiments was conducted to compare the performance of broiler chicks reared on fresh and reused wood shavings litter. In addition, the effect of methyl bromide fumigation of reused litter on subsequent chick growth, feed conversion and mortality was studied. Non-fumigated fresh and reused litters served as controls. Methyl bromide fumigation reduced the total bacterial population of reused litter. This reduction, however, did not result in any significant improvement in body weight gains, feed conversion or mortality. The performance of the chicks reared on the fumigated litter was similar to that of chicks reared on reused litter and slightly superior to that of chicks reared on fresh wood shavings litter. The mortality of chicks reared on fresh litter was slightly lower than in the groups on the reused litters. (White-Iowa State)

## 0044 - A6, A10, B3, B5, D3, E3

**THE DIGESTION OF POULTRY FECES UNDER CAGES,**
Auburn Univ., Ala. Dept. of Poultry Science.
J. R. Howes.
Poultry Science, Vol 47, p 1682, 1968.

Descriptors: *Farm wastes, *Poultry, *Aerobic conditions, Odor, Aerobic bacteria, Fertilizer, Nitrogen, Stabilization, *Waste treatment.
Identifiers: *Absorbent substrate, *Cage operation, *Inoculation, Control plots.

A series of small experiments were carried out under cages with and without concrete floors, using various absorbent substrates for poultry feces. After an initial buildup period, the feces and substrate was inoculated with aerobic bacteria and aerobic conditions maintained by disturbing the surface cake at intervals. These experiments led to a field trial without any absorbent substrate at a large cage operation in south Florida, which has now been in operation for 18 months. Odors and flies have been largely eliminated except in control plots and spraying for fly control greatly reduced. The bulk of the fecal pile was less than half the volume of the control plots due to stabilization of nitrogen and water losses. Feathers were digested if they were incorporated into the fecal pile and the resulting material was a homogenous, odorless fertilizer which has been used in urban gardens and on golf greens. (White-Iowa State)

## 0045 - A11, C2, E3, F6

**THE POTENTIAL DIGESTIBILITY OF CELLULOSE IN FORAGE AND FAECES,**
University of New England, Armidale (Australia). Dept. of Agronomy.
R. J. Wilkins.
Journal of Agricultural Science, Vol 73, No 1, 1969, p 57-64. 1 fig, 6 tab, 35 ref.

Descriptors: *Farm wastes, *Cellulose, *Digestion, *Incubation, Grasses, Forages, Sheep, Nitrogen, Carbohydrates, Organic matter, Analytical techniques.
Identifiers: *Potential digestibility, *Digestibility coefficients, *Cellulose digestibility, Duration of digestion, Rumen, Ryegrass, Cooksfoot, Callide Rhodes grass, Samford Rhodes grass, Lignified and cutinized tissue.

The potential digestibility of cellulose is defined as the maximum digestibility obtainable when the conditions and duration of digestion are not limiting factors. Techniques for measuring potential cellulose digestibility were examined and the relationship between potential digestibility and in vivo cellulose digestibility was explored for a range of grasses. Cellulose digestibility was found to reach a maximum value after 5 days incubation in vitro. No further cellulose was digested when the residues from an initial incubation for 6 days were incubated with a second rumen liquor inoculum. The values measured after a single incubation of 6 days duration were similar to cellulose digestibility coefficients measured by the suspension of ground forage samples in nylon bags in the rumen for 6 days. Plant factors appear to limit further digestion and the residue from prolonged digestion in vitro consisted only of lignified and cutinized tissue. Potential cellulose digestibility measured by either of the above techniques was higher than cellulose digestibility in vivo. The difference varied between forages and when the difference was large, the digestibility of cellulose in faeces was high. It is suggested that measurements of the potential digestibility of cellulose in feed and faeces may be of use in estimating the digestibility of grazed herbage. (White-Iowa State)

## 0046 - A4, A5, A6, F2

**FARM WASTE DISPOSAL-AMENITY AND GOOD NEIGHBOURLINESS,**
K. B. C. Jones.
Great Britain Ministry of Agriculture, Vol 77, No 4, p 165-167, April 1970.

Descriptors: *Farm wastes, *Odor, *Water pollution, *Building codes.
Identifiers: *Noise, *Nuisances, *Legal action, Solid refuse.

A general picture of waste pollution in England's country-side is shown by comparing today's production and disposal with that of yester-year's. Nuisances that are annoying to both farmers and city-dwellers are described. The rights and liabilities of both farmer and city-dwellers are outlined. (Miner-Iowa State)

## 0047 - A11, B1, E1

**PRINCIPLES AND PRACTICES OF BEEF CATTLE FEEDLOTS,**
Queensland Univ., Brisbane (Australia). Dept. of Animal Husbandry.
W. J. Pryor.
Australian Veterinary Journal, Vol 46, No 4. April 1970, p 173-177. 2 tab, 1 fig, 17 ref.

Descriptors: *Cattle, *Animal diseases, *Costs, Profit, Nutrient requirements, Silage, Sorghum, Wheat, Performance, Water pollution control.
Identifiers: *Feedlots, Feelot management, Feeding systems, Green chop.

It is believed the emergence of a large feedlot industry will be dependent primarily on two factors, the first being the availability of cheap feed and the availability of store cattle at a price which will permit a margin after they have been lot fattened, and the other, the introduction of a satisfactory national system of carcass grading and identification. A description is given of the principles involved in the management of feedlots with special reference to conditions operating in northern Australia. The importance of concentrate to roughage ratios and protein and mineral requirements are stressed. Diseases have played only a minor part in feedlot management in Australia thus far, and it is suggested that the veterinarian can play a more useful role in supplying sound advice on economic feeding and management. (White-Iowa State)

## 0048 - A8, E2

**SOIL FERTILITY UNDER CONTINUOUS CULTIVATION IN NORTHERN NIGERIA. I. THE ROLE OF ORGANIC MANURES,**
R. G. Heathcote.
Experimental Agriculture. Vol 6, No 3, p 229-237, 1970. 13 tab, 14 ref.

Descriptors: *Trace elements, *Limiting factors, Farm wastes, Fertilizers, Crop response, Deficient elements.
Identifiers: Organic fertilizers, Nigeria, Organic manures.

Soil acidity, incipient potassium deficiency, and a deficiency of one or more trace elements were limiting factors in three trials of long-term soil fertility changes under continuous cultivation in the Sudan Savanna zone of Nigeria. The effectiveness of organic manures is explained largely or wholly in terms of these factors, since no evidence has yet been found to suggest that the addition of organic matter as such is of value. (Christenbury-Iowa State)

## 0049 - A8,B5,C2,D1,D3,E2

**USE OF SOIL TO TREAT ANAEROBIC LAGOON EFFLUENT RENOVATION AS A FUNCTION OF DEPTH AND APPLICATION RATE,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. K. Koelliker, and J. R. Miner.
Transactions of the American Society of Agricultural Engineers, Vol 13, No 4, p 496-499, July-August 1970. 3 fig, 4 tab, 19 ref.

Descriptors: *Denitrification, *Nitrogen, *Irrigation, Farm wastes, Chemical oxygen demand, Lagoons, Nitrates, Nitrites, Ammonia, Bacteria, Treatment, Disposal, Anaerobic conditions, Waste water treatment.
Identifiers: *Nitrogen balance, Nitrobacter, Nitrosomonas, Lagoon effluent, Application rates.

This paper reports the findings from a study where lagoon effluent was applied to soil for final treatment. The active soil profile appears to offer great potential as a final treatment media for partly treated animal wastes. Anaerobic livestock-lagoon effluent sprinkled on grass-covered soil profile reduced the COD, phosphorous, and nitrogen concentrations 95, 99, and 80 percent, respectively in 3 months. Loading range was 13.9 to 30.5 in. of lagoon effluent. Removal of COD was attributed to biological activity and physical filtration in the upper inches of soil. Phosphorus reduction resulted from chemical activity of the clay fraction near the soil surface. Nitrogen reduction was attributed primarily to dentrification in the soil profile. It was recommended that if nitrogen reduction is a goal in waste water disposal, a rather wet schedule should be followed. The applied waste water should contain some organic load so that a substrate will be provided for the denitrifying bacteria. (Christenbury-Iowa State)

## 0050-A8,B1,E1

**TREATMENT AND DISPOSAL OF ANIMAL WASTES,**
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
Industrial Water Engineering. Vol 7, No 11, p 14-18, November 1970. 3 fig.

Descriptors: *Farm wastes, Lagoons, Drying, Nutrients, Disposal, Inorganic compounds, Nitrogen, Phosphorus, Nitrification, Denitrification, Confinement pens, Waste water treatment.
Identifiers: Holding tanks, In-house ditches, Oxidation ditches, Separation of wastes, Composting, System.

Due to confinement feeding of livestock it has become doubtful from the profit standpoint to recycle manure by applying it to land. There has been an increase of 120% in the number of cattle of feed in the last 15 years. Laws are being considered which make it mandatory to reduce the pollution potential of livestock waste. The nine most feasible systems for animal waste disposal are discussed. These systems utilize either holding tanks, in-house ditches, separation of wastes, or drying and composting. These systems will remove most of the organic-oxygen-demanding material but not the inorganic nutrients. Land disposal has been effective for disposal of phosphorous. However land disposal for nitrogen may not be adequate. Two techniques for reducing the nitrogen load in animal waste is through ammonia release and the nitrification-denitrification cycle. (Christenbury-Iowa State)

## 0051 - A4, A9, A11, A13

**IMPACT OF AGRICULTURAL POLLUTANTS ON WATER USES,**
Robert S. Kerr Water Research Center, Ada, Okla.
James P. Law, Jr., and Harold Bernard.
Transactions at the American Society of Agricultural Engineers, Volume 13, No 4, p 474-478, July-August 1970. 3 tab, 23 ref.

Descriptors: *Farm wastes, *Irrigation, *Salinity, *Pollutants, *Fertilizers, *Water pollution sources, Biochemical oxygen demand, Chemical oxygen demand, Disposal, Livestock, Agricultural chemicals, Aquatic life, Water quality, Fish, Dissolved oxygen, Aesthetics, Recreation, Pollutant identification.
Identifiers: *Agricultural pollutants, *Aesthetic value, Total salt, Primary contact recreation, Secondary contact recreation.

This paper discussed the water pollution potential of agricultural sources. Animal wastes, irrigation return flows, fertilizer application, and pesticides are the primary sources of agricultural pollutants. The water-quality criteria for water supplies are discussed as related to agricultural contaminants. Data is presented for the desirable and permissible limits of concentration for the various contaminants. Agricultural is responsible for a major portion of the total salt in many rivers and streams. Data is given for the proposed safe limits of water salinity for livestock. The impact that agricultural pollutants has on fish, other aquatic life, and wildlife is discussed. Examples are cited where pollutants have adversely affected fish and wildlife. Now is the time to build the cost of clean water into all of our operations. (Christenbury-Iowa State)

## 0052 - A5, C2, F6

**NITROGEN CONTAMINATION OF GROUNDWATER BY BARNYARD LEACHATES,**
Guelph Univ. (Ontario). Dept. of Soil Science.
R. W. Gillham, and L. R. Webber.
J Water Pollut Contr Federation, Vol 41, No 10, p 1752-1762, Oct 1969. 11 p, 10 fig, 2 tab, 13 ref.

Descriptors: *Farm wastes, *Cattle, *Leaching, *Water pollution sources, Path of pollutants, Water pollution effects, Nutrients, Groundwater movement, Nitrogen, Waste water (Pollution).
Identifiers: Cattle wastes, Feedlot wastes.

A zone of nitrogen-contaminated groundwater associated with a barnyard was studied to determine the quantity of inorganic nitrogen reaching the groundwater from the barnyard. From piezometric potential and hydraulic conductivity measurements, quantitative flow nets were drawn permitting groundwater discharge calculations. An increase from 2 to 15 mg/l inorganic nitrogen occurred in the groundwater as it passed beneath the barnyard. This resulted in a contribution of 4.4 lb (2.0 kg) of inorganic nitrogen made by the barnyard to the groundwater during the 5-month study period. The concentration of nitrogen was related to the direction of groundwater flow and was dependent on the presence of conditions suitable for the leaching of nitrogen and the dilution potential of the local groundwater flow system. The surface topography proved to be a poor indication of the direction of groundwater flow. (Knapp-USGS)

## 0053 - B1, E1

**FARMYARD MANURE HANDLING.**
Ministry of Agriculutre, Fisheries and Food, Lon-

don (England).

Mechanization Leaflet For Farmers and Growers, No 8, December 1965. 6 p.

Descriptors: *Farm waste, *Disposal, *Equipment, Operations, Waste water treatment.
Identifiers: *Machinery, *System, Loaders, Spreaders, Scrapers, United Kingdom.

This leaflet describes the more important types of equipment and working methods used at present in the United Kingdom for farmyard manure handling. Loading and spreading equipment are discussed. Recommendations are made as to the most efficient methods of combining the available men and equipment into an operating system for manure disposal. (Christenbury-Iowa State)

### 0054 - A2, A4, B1, F1

**POLLUTION POTENTIAL OF LIVESTOCK FEEDING OPERATIONS IN SOUTH DAKOTA,**
South Dakota State Univ., Brookings. Dept. of Civil Engineering.
James N. Dronbush.
Sponsored by the SDSU College of Agriculture and Biological Sciences, and the College of Engineering. Proceedings South Dakota Agriculture and Water Quality - A Symposium on Water Pollution, 1970, p 37-46, 4 tab, 3 fig.

Descriptors: *South Dakota, *Runoff, *Pollutants, Farm wastes, Lagoons, Cost sharing, Locating, Cattle.
Identifiers: *Pollution potential, *Population equivalents, Feedlots.

The overall pollution problem for livestock feeding operations may not be as critical in South Dakota as has been assumed. Certain climatic factors appear favorable, nevertheless, feedlots poorly locited with excessive drainage may be expected to cause problems especially to lakes. General prinicples are available as guide lines for construction to control pollution and cost sharing is available. Although research can be expected to provide greater related knowledge, there appears to be little excuse for delaying the program of active feedlot pollution control particularly with all planned new construction for expansion of the feeding industry. (Christenbury-Iowa State)

### 0055 - A1,B1,C2,C3,E1,F4

**MISSION IMPOSSIBLE: DISPOSE ANIMAL WASTES,**
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. Paul Taiganides.
Purdue University, Engineering Extension Service, Bulletin No 135, p 542-549, 1969. 1 fig, 4 tab, 10 ref. (Proceedings 24th Industrial Waste Conference).

Descriptors: *Transportation, *Disposal, *Management, Farm wastes, Lagoons, Production, Anaerobic digestion, Aerobic treatment, Biochemical oxygen demand, Gases, Dehydration, Odor.
Identifiers: *Generation, *Processing, *Utilization, Waste management, Anaerobic lagoons, Gas production, Composting.

The development of a 'waste management technology' analogous to the new patterns of animal production and in harmony with our need to keep our natural resources from being polluted is not an impossible mission but rather a challenging mission whose resolution is requiring of engineers and scientists the same ingenuity that has been shown in developing modern methods of production of consumer goods. This paper discusses the changes and trends in the components of animal waste management. The discussion is divided into five areas: waste generation, waste transportation, waste processing, waste utilization and waste disposal. (Christenbury-Iowa State)

### 0056 - B1, D1, D3, F6

**PRELIMINARY RESULTS OF A NOVEL BIOLOGICAL PROCESS FOR TREATING DAIRY WASTES,**
Allis-Chalmers Manufacturing Co., Milwaukee, Wis.
Ronald L. Antonie, and Fred M. Welch.
Purdue University, Engineering Extension Service, Bulletin No. 135, p 115-126, 1969. Proceedings 24th Industrial Waste Conference.

Descriptors: *Equipment, *Aerobic conditions, *Biological treatment, *Biomass, Farm wastes, Aeration, Microorganisms, Biodegradation, Chemical oxygen demand.
Identifiers: *Loading rate, Rotating Biological Contractor, Field test.

Field testing of a device called the 'Rotating Biological Contractor' or 'RBC' is the subject of this paper. The device consists of a series of discs which are mounted on a shaft and rotated while partially submerged in the waste to be treated. A microbial film develops on the surface of the discs. The rotation of the discs carry the microorganisms into the air for aeration so that they can carry on aerobic activity. The field tests have shown that the RBC can effectively treat waste from a dairy plant. Varying weather conditions have no apparent effect on RBC effectiveness. RBC characteristics of a large microbial population, flexible aeration capacity, little maintenance, low power requirements and predictable performance make the RBC an attractive process for biological treatment of dairy wastes. (Christenbury-Iowa State)

### 0057 - A7, A11, B1, C2

**THE MENACE OF NOXIOUS GASES IN ANIMAL UNITS,**
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. Paul Taigonides, and Richard K. White.
Transactions of the ASAE, Vol 12, No 3, 1969, p 359-362, 367. 2 tab, 18 ref.

Descriptors: *Farm wastes, *Gases, *Effects, Carbon dioxide, Oxygen, Ammonia, Hydrogen sulfide, Methane, Lethal limit, Toxicity, Cattle, Hogs, Poultry, Ventilation, Treatment.
Identifiers: *Concentrations, Storage pits, Pit cleaning, Lethal situations.

The paper begins with a description of noxious gases and it is noted that animal deaths have occurred as the result of an accumulation of these gases. The gases, their properties and characteristics listed, are carbon dioxide, ammonia, hydrogen sulfide, methane, and other gases. Oxygen is listed to show its indispensability inside a confinement building. Animal response to menacing concentrations of these gases is described. A table lists different properties of the noxious gases and their physiological effects on the animals. Possibly fatal concentrations are noted, along with the potentially lethal situations which may bring about these concentrations. Among these situations are ventilation breakdowns, pit stirring and pit cleaning. Finally, the control of noxious gases is emphasized. Preventive measures, moderating the effects of noxious gases, and treatment of affected animals are all discussed. (White-Iowa State)

### 0058 - A6, B2, E3

**REUSE OF WASH WATER FOR CLEANING CAGED LAYER HOUSES,**
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
R. L. Witz, G. L. Pratt, and J. L. Sell.
Transactions of the ASAE, Vol 12, No 6, p 807-812, November 1969. 7 fig.

Descriptors: *Recirculated water, Farm wastes, Poultry, Storage tanks, Equipment, Odor.
Identifiers. Flushing gutters, Manure.

A liquid manure handling system was designed for a poultry house. Manure is collected in concrete gutters beneath the cages. A flushing process is used to clean the gutters. A wooden scrape is forced down the length of the gutter by pressure exerted by water that had been added behind the scrape. The water was collected in an outside pit for reuse. This system has been effective for reducing the total quantity of water required for cleaning the poultry house. (Christenbury-Iowa State)

### 0059 - A10, B1, F1

**THE MANAGEMENT OF LIVESTOCK MANURE,**
California Univ., Davis. Dept. of Agricultural Engineering.
S. A. Hart.
Transactions of the ASAE, Vol 3, p 78-80, 1960. 4 fig, 1 tab, 13 ref.

Descriptors: *Farm wastes, *Disposal, *Management, Storage, California, Dehydration, Livestock, Fertilizers, Value.
Identifiers: *Composting, *Sanitation, Processing, House fly, Musca domestica, Carbon to nitrogen ratio, Production.

Manure management will seldom be a profit-making part of the farming enterprise. In most cases the cost of proper handling will exceed the value of the manure as a fertilizer or soil amendment. Even so, manure handling is as necessary a chore as is feeding or animal care. Through proper manure management the net cost of handling the manure can be minimized and the sanitation requirements of the farming operation fulfilled. The procedures of systems engineering are applicable to the management of livestock manure, and can be stated as the specific operations of: (a) gathering and cleaning up the manure, (b) storing or processing it, and (c) utilizing or disposal of it. (Christenbury-Iowa State)

### 0060 - A5, A9, E2

**RELATION OF AGRICULTURE TO GROUND-WATER POLLUTION: A REVIEW,**
North Carolina State Univ., Raleigh.
J. W. D. Robbins, and G. J. Kriz.
Trans Amer Soc Agr Eng, Vol 12, No 3, p 397-403, May-June 1969. 7 p, 2 tab, 97 ref.

Descriptors: *Agricultural engineering, *Groundwater, *Pollutants, *Farm wastes, Agriculture, Pollution abatement, Farm management, Waste water (Pollution), Pesticides, Insecticides, Herbicides, Bibliographies, Saline water, Irrigation water, Waste water disposal, Waste disposal, Water pollution, Water pollution control, Water Pollution sources.
Identifiers: Groundwater quality, Pollution control.

Groundwater is a water resource and a potential medium for receiving wastes. Agricultural enterprises produce wastes that can lead to rapid degradation of groundwater. Agricultural engineers are responsible for evaluating agricultural groundwater pollution problems and recommending control and abatement measures. The purpose of this paper is to orient agricultural engineers on groundwater pollution problems caused by agricultural practices in 3 general areas: (1) evaluation of groundwater as a receiving medium for agricultural wastes; (2) characterization of the source of the pollutants; and (3) delineation of the types of solutions needed for agricultural groundwater quality problems. Agricultural groundwater pollutants reviewed are animal wastes, fertilizers, pesticides, plant residues, and saline waste water. (USBR)

## 0061 - A3, C2

**SURFACE RUNOFF AND NUTRIENT LOSSES OF FENNIMORE WATERSHEDS,**

Wisconsin Univ., Madison. Dept. of Agricultural Engineering State of Wisconsin.
S. A. Witzel, Neal E. Minshall, M. Starr Nichols, and John Wilke.
Transactions of the ASAE, Vol 12, No 3, 1969, p 338-341. 4 tab, 3 fig, 5 ref.

Descriptors: *Surface runoff, *Nutrients, Fertilizers, Farm wastes, Nitrogen, Phosphorus, Potassium, Wisconsin, Agricultural watersheds, Discharge, Soils, Topography, Geology, Cover crops, Weirs, Precipitation, Snow.
Identifiers: *Runoff sampler, Fennimore, Wisconsin.

The paper describes the soils, geology, topographic features and cover of a 330 acre watersheo near Fennimore, Wisconsin. The watershed was subdivided and wiers were placed with semi-automatic runoff samplers to sample winter runoff water. The amount of commercial fertilizer as well as manure that was applied was determined. The runoff samples were analyzed and the amount of nutrients lost was calculated from the wier calibration. The amount of runoff during the winter of 1967 was about twice the 29 year average. The nutrients lost in surface runoff were much greater than those in the base flow of southwestern Wisconsin streams. In a year of average runoff, assuming nutrient losses directly proportional to runoff, the losses would be 2 lb. nitrogen, 0.6 lb. phosphorus and 4 lb. potassium per acre. (White-Iowa State)

## 0062-A2,A4,A5,B1,C2,E2

**MANAGEMENT OF CATTLE FEEDLOT WASTES,**

Iowa State Water Resources Research Inst., Ames.
Richard R. Dague, and Kenneth J. Kline. Iowa State Water Resources Research Institute Report No 69-4, Iowa University, Project Completion Report, June 30, 1969. 195 p, 99 fig, 20 tab, 19 ref, 4 append.

Descriptors: *Farm wastes, *Confinement pens, *Waste treatment, *Waste disposal, Lagoons, Water pollution control, Water pollution sources.
Identifiers: Feedlot wastes, Waste management.

The effects of hydrologic factors on the control of runoff from open feedlots were studied. Management and treatment techniques are discussed and evaluated. Rainfall, runoff, and streamflow are the primary factors to consider in managing cattle feedlot runoff. The nature, volume, and rate of delivery of runoff are directly related to rainfall. Storage requirements depend upon the volume of runoff, whereas the retention pond discharge rate should be proportional to streamflow. Terraces and retention ponds will reduce the pollution from cattle feedlot runoff. Application to land appears to be the most practical method of disposal for both the solids and the liquid. When applied to agricultural land, the waste has some economic value. Retention ponds may not remove sufficient amounts of suspended solids, BOD, COD, and nutrients to provide safe effluents for disposal to streams. (Knapp-USGS)

## 0063-A4,A5,A7,A8,A9,F4

**SOIL POLLUTANTS: THEIR ORIGIN AND BEHAVIOR,**

Guelph Univ. (Ontario). Dept. of Microbiology.
D. E. Elrick, J. W. Biggar, and L. R. Webber.
Journal Soil Water Conservation, Vol 21, p 7-11, 1966. 3 fig, 26 ref.

Descriptors: *Pollutants, *Pesticide residues, *Degradation (Decomposition), Farm wastes, Pollutant identification, Effluents, Pesticides, Sewage, Domestic wastes, Disposal, 2-4-D, DDT, Chlorides, Radioactive wastes, Air pollution effects.
Identifiers: *Contaminants, Biological contaminants.

Pesticides, industrial and municipal wastes, radioactive materials, microbes, and other potential pollutants are coming in contact with our soils in ever increasing amounts. This article discusses certain sources of soil contaminants and outlines a few of the research techniques being used in an attempt to understand their behavior in soils. Agricultural chemicals may become harmful pollutants if improperly used. Sewage and industrial wastes make up the bulk of contaminating substances produced by our society. Waste disposal is related to biological contamination of water supplies by bacteria and viruses. Radioactive contamination and some air pollutants come into contact with the soil. The movement of some of the soil pollutants is discussed. (Christenbury-Iowa State)

## 0064 - A11, C2

**URINARY CREATININE AS AN INDEX COMPOUND FOR ESTIMATING RATE OF EXCRETION OF STEROIDS IN THE DOMESTIC SOW,**

Purdue Univ., Lafayette, Ind.
R. E. Erb, S. A. Tillson, G. D. Hodgen, and E. D. Plotka.
Journal Paper No 3644, Purdue University Agricultural Experiment Station. Journal of Animal Science, Vol 30, No 1, p 79-85, January 1970. 5 tab, 20 ref.

Descriptors: Farm wastes, Urine, Hogs, Livestock, Animal physiology.
Identifiers: *Steroids, *Creatinine, Index compound.

During two experiments urine was collected form 36 yearling sows to estimate rate-of-excretion of creatinine and to evaluate its use as an index compound. Excretion rate averaged 205 mg/hr. and 1.35 mg/hr./kg live weight for Experiment I as compared to 201 mg/hr. and 1.38 mg/hr./kg live weight for Experiment II. Measurement of urine volume for 48-hr. allows estimation of creatinine excretion rate of sows with coefficients of variability of 7-8%. In comparison, the coefficients of variability were 18 and 13%, respectively, for 12-hr. and 24-hr. periods. These experiments show that the ratio, microgram steroid per mg urinary creatinine is an accurate method for expressing rate of excretion of steroids in urine. (Christenbury-Iowa State)

## 0065-A1,A6,A9,A11,A12,B1, E2

**AGRICULTURE POSES WASTE PROBLEMS.**

Environmental Science and Technology, Vol 4, No 12, p 1098-1100, December 1970. 2 fig.

Descriptors: *Farm wastes, *Pollutants, *Wastes identification, *Environmental effects, Water pollution sources.
Identifiers: *High intensity farming, Contamination, Plant emissions, Government action.

Increasing concentration and intensity of agricultural activities necessary to the development and prosperity of the economy, are responsible for many new environmental issues. Primary sources of pollution resulting from agricultural practices can be grouped as: animal wastes, wastes from processing of raw agricultural products, rural domestic wastes, and sediment from land; also plant nutrients from fertilizers, inorganic salts and minerals resulting from irrigation, pesticides, aeroallergens and infectious agents contribute to the problem; particulate and gaseous substances derived from the combustion of wastes and natural plant emmissions add to the problem. A brief description of these sources and some possible solutions are presented. (Christenbury-Iowa State)

## 0066 - A11, B2, D3

**THE EFFECTS OF VOLUME AND SURFACE AREA ON THE RATE OF ACCUMULATION OF SOLIDS IN INDOOR MANURE DIGESTION TANKS,**

Nebraska Univ., Lincoln.
Ali A. Al-Timimi, W. J. Owings, and John L. Adams.
Poultry Science, Vol 44, p 112-115, 1965. 3 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Digestion tanks, Volume, Least squares method, Overflow, Lagoons, Waste treatment.
Identifiers: *Surface area, Dry matter, Hen weight, Feed consumption, Egg weight.

Ten stainless steel tanks were utilized to form four volume and two surface area allowances. Leghorn type pullets were placed in eight inch cages over the tanks and their manure was allowed to accumulate in liquid for 20 weeks. At the end of each 2 week period, dry matter determinations were made and hen weight, feed weight and egg production were recorded. The dry matter percentages were put on a 3.5 cu. ft/bird basis and the changes in per cent dry matter from one period to another were calculated. Cubage and surface area per bird seemed to have no significant effects on the rate of digestion of the solids in the tanks. Periods and the interaction between treatments and periods were highly significant. Although the manure output is influenced by factors such as hen weight, feed consumption and egg weight, none of these factors showed any significant effect, because of the uniform distribution of the hens assigned to the treatments. Liquid overflow was inversely related to the surface area per bird. At least 3.5 cu. ft of water per bird is needed to provide for biennial cleaning. (White-Iowa State)

## 0067 - B2, E2, F1

**EFFLUENT DISPOSAL - STILL A MAJOR PROBLEM,**

Wright Raine Ltd.
W. T. A. Rundle.
Journal and Proceedings of the Institution of Agricultural Engineers, Vol 21, p 134-139, 1965. 5 fig, 5 tab.

Descriptors: *Farm wastes, *Slurries, Sludge, Sprinkler irrigation, Pumping, Storage tanks, Labor, Volume, Rates of application.
Identifiers: *Field spreading, Vacuum tanks, Mechanical agitation.

Equipment and methods of manure disposal used in handling manure slurries are described. The equipment is broadly divided into two categories including mobile trailer type equipment and pumping equipment. Several examples of each are given. Tables list the waste production and labor required for each system as a function of volume handled. A digester is also described, which reduces the volume of material put in by 20%, and produces a sludge with no smell. It is suggested that the cost of this operation would be prohibitive. A discussion follows centering on problems and solutions to problems which have arisen from the systems discussed. (White-Iowa State)

## 0068 - A12, A13, F2

**POSSIBLE DEFENSES AGAINST NUISANCE COMPLAINTS,**

Illinois University.
H.W. Hannah.
Poultry Digest, p. 601, December 1970.

Descriptors: *Legal aspects, farm wastes, poultry.
Identifiers: Nuisance complaints.

H.W. Hannah has outlined six possible defenses that may be used by poultrymen against nuisance complaints. These include that the plaintiff is oversensitive and/or does not have the facts correct. The poultryman may claim that he was there first and/or that the area is zoned for agricultural use. The poultryman may claim that he has considerable investment in the operation. The poultryman may claim that the conditions will improve if granted additional time. (Christenbury-Iowa State)

### 0069 - A4,B2,E2,F2

**CONNECTICUT REQUIREMENTS FOR LIQUID MANURE DISPOSAL,**
Connecticut Public Health Department

Poultry Digest, December 1970, p. 583.

Descriptors: *Connecticut, *regulation, *liquid wastes, farm wastes, pollutants, wastes disposal, water pollution.
Identifiers. Liquefied manure.

The Connecticut Public Health Department has set forth requirements that poultrymen and others must follow. Liquefied manure should be spread on level fields so that it does not come within 200 feet of any watersupply. No liquefied manure should be applied to frozen or snow-covered ground. No liquid manure should be applied when ground is saturated with rainfall or groundwater. No more than 5,000 gallons of liquid manure per acre should be applied at any one time. The fields should be given a rest period so that digesting of organic material can occur in the soil. (Christenbury-Iowa State)

### 0070 - A5,A8,C2,E2

**SOILS AS AN ANIMAL WASTE DISPOSAL MEDIUM,**
Minnesota Univ., St. Paul. Dept. of Soil Science.
William P. Martin.
Journal of Soil and Water Conservation, Vol 25, p 43-45, March-April 1970. 18 ref.

Descriptors: *Farm wastes, *Sails, Nitrogen, Phosphorous, Potassium, Soil water, Water pollution, Soil contamination, Soil surveys, Nutrients, Fertilizers, Soil properties, Value, Soil chemical properties, Soil physical properties, Soil erosion, Sedimentation, Minnesota.
Identifiers: Waste disposal medium.

Pollution of the soil-water complex occurs mostly because we have no other medium for waste disposal. The author discusses the various reactions which can be expected in soil with respect to nitrogen, phosphorous and potassium. The importance of erosion and sedimentation control is also pointed out. It was stressed that considerable additional information is needed if we are to maximize the use of the soil as a waste disposal medium in such a way as to minimize pollution. We must manage our natural resources to accomodate our waste disposal needs with a minimum of pollution and still produce nutritious food in adequate amounts for our rapidly increasing population. (White-Iowa State)

### 0071 - A2,A4,A5,A8,B1,B5,C2

**ENGINEERING ANALYSIS OF CATTLE FEEDLOTS TO REDUCE WATER POLLUTION,**
Texas Technological Coll., Lubbock. Dept. of Civil Engineering.
W. Grub, R. C. Albin, D. M. Wells, and R. Z. Wheaton.
Transactions of the American Society of Agricultural Engineers, Vol 12, 1969, p 490-492, 495. 2 tab, 5 fig, 3 ref.

Descriptors: *Farm wastes, *Cattle, *Water pollution sources, Runoff, Precipitation, Nitrogen, Phosphorus, Biochemical oxygen demand, Slopes, Surfaces, Feeds, Silage, Management, Design, Waste water treatment.
Identifiers: *Feedlots, *Ration composition, Feedlot layout, Waste accumulation.

Incorporating both engineering and biological aspects, this report contains an analysis of data and suggests management and design practices that could reduce materially the pollution contributed by the confined land area where feeder cattle are maintained. The study was conducted in two phases. The first phase was concerned with the waste accumulation on the feedlot surface as influenced by ration. The second phase of the project was concerned with determining the quality of liquid runoff as related to the rations fed to cattle, as related to the time of accumulation of the manure pack. For the first phase, ration composition, its effect on quantity of excretion, and changes in the accumulated wastes are looked at. For the second phase, the effects of precipitation, surfacing material, land slope, depth of waste accumulation, feedlot layout, and ration composition are evaluated. Nitrogen, phosphorus and BOD were used as measures of pollution. (White-Iowa State)

### 0072 - A11,E2

**A NOTE ON THE UTILISATION BY CHICKENS OF ENERGY FROM FAECES,**
Queensland Univ., Brisbane (Australia). Dept. of Animal Husbandry.
W. J. Pryor, and J. K. Connor.
Poultry Science, Vol 43, p 833-834, 1964. 2 tab, 2 ref.

Descriptors: *Farm wastes, *Poultry, Energy, Wheat, Sorghum, Nitrogen.
Identifiers: *Metabolizable energy, Bomb calorimeter, Ration.

Four groups of male chickens aged 22 days which had been on a trial to determine the metabolizable energy of grain sorghum, were allotted at random two to each treatment. Two groups were fed crushed grain sorghum. The remaining two groups were fed a ration consisting of 80% crushed grain sorghum mixed with 20% feces resulting from a previous wheat trial. All four rations contained a standard broiler mineral and vitamin supplement. The results showed that the feces had a metabolizable energy value of approximately 30% of the feed from which it originated. (White-Iowa State) .

### 0073 - A1,A4,A7,F2

**STOCKMEN'S LIABILITY UNDER THE MISSOURI NUISANCE LAW,**
Missouri Univ., Columbia.
Donald R. Levi, and John C. Holstein.
Science and Technology Guide, Published by the University of Missouri-Columbia Extension Division; File: Ag Econ 3 3/70, 7M. p 581-584, (Mar 1970).

Descriptors: *Legal aspects, *Regulation, Farm wastes, Missouri.
Identifiers: *Pollution laws, *Nuisance law, *Legal procedure, *Liability, Lawsuits, Stockmen.

There is no one thing a livestock operator can do and gain absolute protection under the nuisance law. Thus, it is imperative that you attempt to prevent such lawsuits from arising. This implies that those who follow a 'good neighbor' policy are less likely to be sued. Try to avoid causing your neighbors discomfort. This guide only discusses some general principles affecting the civil liability of feedlot operators under the nuisance laws. If you are faced with potential air or water pollution problem, don't hesitate to disucss it with your attorney. (Christenbury-Iowa State)

### 0074 - A6,A7,B2,C1,C2,D3

**AEROBIC DIGESTION OF SWINE WASTE,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. D. Jones, J. C. Converse, and D. L. Day.
Proceedings of CIGR (Commission Internationale du Genie Rural), p 204-211, 1969. 7 fig, 2 ref.

Descriptors: *Oxygenation, *Aeration, *Foaming, Biochemical oxygen demand, Farm wastes, Swine, Lagoon, Dissolved-oxygen, Aerobic treatment, Odor, Gases, Liquid wastes, Waste water treatment.
Identifiers: *Oxidation ditch, *Total solids, Loading rate, Defoaming agent, In-the-building treatment.

An oxidation ditch for in-the-building treatment of swine waste was evaluated. Odorless aerobic treatment could be obtained under the self-cleaning slatted floors of a confinement building by connecting the ends of the liquid-manure gutters and adding a rotor aerator. The results indicate that loading rates of 6 cu. ft. or less per hog are not suitable for in-the-building, oxidation-ditch treatment. Loading rates of 8 cu. ft. per hog were most satisfactory. Oil was used as a defoaming agent when required. No foaming was encountered at loading rates higher than 8.5 cu. ft. per hog provided sufficient oxygen was supplied. The mixed-liquor, 5-day BOD of swine waste was reduced from 40,000 to 3,000 to 10,000 milligrams per liter. (Christenbury-Iowa State)

### 0075 - A6,A7,B2,C2,C3,D3,F1,F5

**HOG WASTE DISPOSAL BY LAGOONING,**
Illinois Dept. of Public Health, Springfield, Ill. Div. of Sanitary Engineering.
Charles E. Clark.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 91, No SA6, p 27-41, December 1965. 5 tab, 1 fig, 9 ref.

Descriptors: *Farm wastes, *Farm lagoons, Odor, Scum, Gases, Bubbles, Biochemical oxygen demand, Chemical oxygen demand, Coliforms, Sampling, Depth, Volume, Septic tanks, Dissolved oxygen, Costs, Nutrients, Chlorophyta, E. coli, Antibiotics, Nitrogen, Potassium, Phosphorus, *Hogs.
Identifiers: *Lagoon supernatant, Shock loading, Surface area, Farrowing house, Feeding house, Total solids, Volatile solids, Enterococcus, Penicillin, Algal population.

The material presented consists of on-site observations and test results obtained from samples collected from an operational farm lagoon in Illinois. The program centered on this lagoon since others around it had failed. The system itself is described and possible solutions given as to why it does work. Chemical properties of the lagoon supernatant and the raw waste are compared. On the basis of observations made during this program, the most likely problem will be process failure caused by antibiotic effect, temperature change or shock loading. Studies are underway concerning the harvesting and feeding of algae from the lagoon. Operational problems as well as costs are evaluated for the total system. Finally, a practical system is suggested for the disposal of hog wastes. (White-Iowa State)

### 0076 - A5,C2

**NITRATE AND OTHER WATER POLLUTANTS UNDER FIELDS AND FEEDLOTS,**
Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
B. A. Stewart, F. G. Viets, Jr., G. L. Hutchinson, and W. D. Kemper.
Environmental Science and Technology, Vol 1, No 9, p 736-739, September 1967. 2 fig, 1 tab, 1 ref.

Descriptors: *Nitrogen, *Nitrates, *Farm wastes, Groundwater, Water pollution, Water table, Soils, Irrigation, Fertilizers, Precipitation, Corn, Hydraulic conductivity, Carbon, Oxidation-reduction potential, Alfalfa, Ammonium compounds, Colorado.
Identifiers: Feedlots, Soil cores, Groundwater pollution, South Platte.

Agriculture's effect on nitrate pollution of groundwater was investigated in the South Platte valley of

Colorado. The valley is intensively farmed and contains many concentrated livestock feeding operations. A water table, generally between 3 and 20 meters below the surface, underlies much of the area. The average total nitrate-nitrogen to a depth of 6.7 meters in the profiles for the various kinds of land use was: alfalfa (13 cores), 70; native grassland (17 cores), 81; cultivated dry land (21 cores), 233; irrigated fields not in alfalfa (28 cores), 452; and feedlots (47 cores), 1282 kg. per hectare. Groundwater samples often contained high concentrations of nitrate, and those obtained beneath feedlots contained ammonium-nitrogen and organic carbon. (White-Iowa State)

### 0077 - B1, B2

**FARM WASTE DISPOSAL IN RELATION TO CATTLE,**
National Agricultural Advisory Service, London (England)
J. Gibbons.
Water Pollution Control, Vol 67, No 6, 1968, p 622-626, 2 tab, 4 ref.

Descriptors: *Disposal (Wastes), *Waste treatment, *Cattle, *Livestock, *Farm wastes, Costs, Silage, Effluent, Economic impact, Digestion, Drains, Groundwater, Streams, Buildings, Construction.
Identifiers: *Farm waste disposal, *Farm waste production, *Cow cubicles, *Dry-land farm, *Silage effluent, *Wet farms, Population equivalents of farm waste, Farming patterns, Solid systems, Organic irrigation, Slurry handling, Cubicle-housing/law labour system, Storage.

Changes in the pattern of farming and consequent effects on the nature of manure disposal problem on farms are discussed. Modern systems of dairy farming, including the special impacts of widespread production of silage, and the growth of the cubicle system of housing are examined. The consequent effluent disposal problems are evaluated. Design of disposal systems must take into account animal waste quantity estimates and the population equivalents of these farm wastes. Also, a vital factor in design requirements is evaluation of the changing patterns of farming. Waste treatment and disposal are discussed from the viewpoints of solid systems, handling organic irrigation methods, and slurry handling methods. The factors affecting storage requirements and capacities are analyzed. An important consideration in most systems is to keep the volume of contaminated liquid to a minimum and this is a vital factor in building design. Silage effluent treatment is given special attention because of the serious pollution problem which it can create. Special efforts are required to keep silage effluent from entering drains, streams, or groundwaters. Proper system design must consider land use, the type of existing facilities, the scale of enterprise, and type of livestock. Economic and technical considerations jointly should underlie the final design decisions. (D'Arezzo-Texas)

### 0078 - A6, B2

**OXYGENATION CAPACITIES OF OXIDATION DITCH ROTORS FOR CONFINEMENT LIVESTOCK BUILDINGS,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Don D. Jones, Donald L. Day, and James C. Converse.
Purdue University, Engineering Extension Service, Bulletin No. 135, p 191-208. 12 fig, 5 ref Proceedings 24th Industrial Waste Conference.

Descriptors: *Dissolved oxygen, *Oxygenation, Farm wastes, Equipment, Odor, Mass transfer, Theoretical analysis.
Identifiers: *Oxidation ditch, Alpha factor.

The oxidation ditch is one of the most successful methods for treating the staggering volume of animal manure that is being produced at the present time. The purpose of this paper is to present the oxygenation capacities of five aeration rotors tested at the University of Illinois. The rotors were tested in actual field installations with clean tap water in the ditch and the livestock removed. The parameter studies were blade immersion, blade design, rotor speed, and gross power requirements. There is little or no difference in oxygenation capacities between the angle iron bladed rotor and the rectangular plate rotor. The increase in oxygenation capacity is almost linear with depth of immersion or rotor speed. (Christenbury-Iowa State)

### 0079 - A4, C2

**SOURCES OF NITROGEN AND PHOSPHORUS IN WATER SUPPLIES - TASK GROUP REPORT.**

Journal of the American Water Works Association, Vol 59, p 344-366, March 1967. 8 tab, 1 fig, 64 ref.

Descriptors: *Nitrogen, *Phosphorus, Farm wastes, Eutrophication, Great Lakes, Distribution, Fertilizers, Ammonia, Nitrates, Nitrites, Phosphorus, Compounds, Domestic wastes, Detergents, Industrial wastes, Nutrients, Fuels, Water treatment, Rivers, Runoff, Drainage water, Sediment transport, Cultivated lands, Water fowl, Atmosphere, Rainfall, Nitrogen fixation.
Identifiers: *Fertilizer consumption, Concentrations, Urban runoff, Dustfall, Historical trends.

The results of this survey have indicated that nitrogen and phosphorus nutrients are contributed to water in significant quantities from a variety of man-made and natural sources. Data taken from a small scale were extrapolated to large areas of the country. This brings attention both on the sources of most significance as well as on the sources for which additional information is most needed. The estimation of nutrient contributions from various sources is presented in tabular form. The complete elimination of nitrogen and phosphorus nutrients from surface water supplies does not appear economically feasible because the sources are so widespread. Therefore, appropriate efforts must be made to cope with many of the problems that have been created, and increased effort must be devoted to the development of better methods for prevention of algal growth in reservoirs. A more concentrated effort by the water utility profession to reduce the detrimental effects caused by eutrophication of water supplies is recommended. (White-Iowa State)

### 0080 - B2, C1, F6

**FLOW PROPERTIES OF ANIMAL WASTE SLURRIES,**
Pennsylvania State Univ., University Park.
Mahesh Kumar, H. D. Bartlett, and N. N. Mohsenin.
Paper presented at the 1970 winter meeting American Society of Agricultural Engineers, Chicago, Dec 8-11, 1970, Paper No 70-911. 28 p, 7 fig, 2 tab, 26 ref.

Descriptors: *Slurries, *Viscosity, *Viscometers, Farm wastes, Viscous flow, Temperature, *Flow characteristics, Moisture content, Shear strength.
Identifiers: Shear diagrams, Flow behavior indices, Dilution, Pseudoplastic flow, Apparent viscosities, Newtonian fluids, Total solids.

The flow properties of animal waste slurries were studied with the use of a coaxial cylinder-type viscometer to determine shear diagrams, flow behavior indices, viscosity indices and apparent viscosities in relation to dilution, temperature and sawdust bedding content of the slurries. The viscosity of manure slurry decreases with increase in dilution. Flow is Newtonian for total solid content below five per cent. Addition of sawdust decreases the viscosity of slurries. Viscosity of fresh manure decreases with increase of temperature. Manure slurry of four to six percent total solids content is a good compromise between excessive volume of handling and power requirement. (Christenbury-Iowa State)

### 0081-A5, A8, A11, A12, B3 B5, C2, E2

**DISTRIBUTION OF ARSENIC FROM POULTRY LITTER IN BROILER CHICKENS, SOIL, AND CROPS,**
Salsbury Labs., Charles City, Iowa. Dept. of Biochemistry.
Joseph L. Morrison.
Journal of Agricultural and Food Chemistry, Vol 17, p 1288-1290, November 1969. 5 tab, 27 ref.

Descriptors: *Arsenic, *Farm wastes, *Poultry, Soil, Crops, Assay, Alfalfa, Clovers, Correlation analysis, Groundwater, Pesticides.
Identifiers: *Poultry litter, *Arsenical feed additives, Hydrolized feather meal, Poultry tissue, Roxarsone.

The effect of the presence of organoarsenicals from feed additives in poultry house litter was investigated with respect to the distribution of arsenic in chickens raised on this litter, to the distribution of arsenic in soil fertilized with this litter, and to the distribution of arsenic in crops raised on soil fertilized with this type litter. Although measurable amounts of arsenic (15-30 ppm) were found in the litter, the arsenic content of soil and crops was unaffected by the use of poultry litter as fertilizer. Similarly, the arsenic content of birds was unaffected when raised on this type litter. (White-Iowa State)

### 0082 - A11

**HOUSE FLY PUPAE AS FOOD FOR POULTRY,**
Agricultural Research Service, Beltsville, Md.
C. C. Calvert, R. D. Martin, and N. O. Morgan.
Journal of Entomology, Vol 62, No. 4, August 1969, p 938-939, 2 tab, 2 ref

Descriptors: *Waste disposal, *Organic matter, Proteins, Poultry, Foods, Nutrients, Soybeans, Laboratory tests.
Identifiers: *House flies, Pupae, Fats, Waste utilization.

A study was conducted as a part of the waste utilization program to determine if the larvae of the house fly could be used to produce protein and fat from human wastes. Due to the difficulty of collecting sufficient larvae for this experiment, fly pupae were used. Pupae were obtained from a culture that had been maintained at the Beltsville Fly Control Laboratory for 60 generation and held at -10LC until needed. The pupae were dried, ground in a small Wiley mill and analyzed for protein, fat, ash, moisture and other substances. The composition of the amino acid indicated that the protein was of a quality similar to meat or fish meal. In two separate 2 week tests, day old chicks were fed one of two formulations containing fly pupae as a protein and fat source. The results indicate that the fly pupae provided enough protein of sufficient quality to support normal growth of chicks during the first two weeks of life. This study is preliminary and more work is required before a valid comparison can be made with the soybean meal now used. It is conceivable that the house fly could be used to convert waste materials into usable, high quality nutrient supplements and thereby assist in alleviating some of the problems of organic waste disposal. (Goessling-Texas)

### 0083 - A4, A6, B4, E2, F4

**BEEF FEEDLOT OPERATIONS IN ONTARIO,**
Department of Energy, Mines and Resources,

Burlington (Ontario). Canada Centre for Inland Waters.
A. R. Townsend, S. A. Black, and J. F. Janse.
Journal of the Water Pollution Control Federation, Vol 42, Part 1, p 195-208, February 1970. 3 fig, 10 tab, 10 ref.

Descriptors: *Livestock, *Farm mangement, *Farm lagoons, *Runoff, Seepage, Waste storage, Waste disposal, *Farm wastes.
Identifiers: *Cattle feedlots, *Animal housing, *Manure storage.

The beef feedlot industry in Ontario is described with respect to its environmental pollution problem. Approximately 100,000 cattle are on Ontario feedlots with an estimated 300 heat or less per feedlot. Four different types of housing and the associated handling of animal wastes as well as types of pollution from the feedlots is discussed. Animal waste storage should be designed to provide six months capacity and lot runoff storage facilities should be sized to hold the winter snow melt and spring rains until proper waste disposal. The report concludes that feedlot waste disposal will continue to be storage and land disposal rather than treatment and effluent discharge. The three main causes of pollution have been feed storage seepage, feedlot runoff, and land disposal runoff. This report recommends aeration systems such as rotors, aspirators, surface mechanical, and diffused air tubing for odor control. (Waid-Texas)

### 0084 - A6, B2, B4, C2

**FATTY ACID CONTENT AS A MEASURE OF THE ODOUR POTENTIAL OF STORED LIQUID POULTRY MANURE,**
Guelph Univ. (Ontario). Dept. of Microbiology.
R. G. Bell.
Poultry Science, Vol 49, No 4, p 1126-1129, July 1970. 4 fig, 7 ref. Ontario Dept of Food and Agr No 695-04 Research Council of Canada No A5730.

Descriptors: *Poultry, *Legislation, *Odor, Farm wastes, Liquid wastes, Gas chromatography.
Identifiers: Fatty acid content, Odor potential.

An attempt was made to find a correlation between odour and the concentration of volatile fatty acids in stored liquid poultry manure. Using both gas chromatographic and column partition chromatographic analysis procedures a relationship between the odour and the fatty acid content of stored liquid poultry manure was observed. A total fatty acid content of 0.1% is suggested as a maximum level to be deemed acceptable for new installations and 0.2% as a minimum level for the initiation of prosecution which may be contemplated for existing facilities. (Christenbury-Iowa State)

### 0085 - A7, B2, B4

**DANGEROUS GASES IN AGRICULTURE.**
Ministry of Agriculture, Fisheries and Food, London (England).

Agriculture, Vol 77, No 9, p 431-432, September 1970.

Descriptors: *Gases, Farm wastes, Storage pits, Slurries, Accidents, Waste treatment.
Identifiers: Bacterial decomposition.

Gases from slurry.pits can be dangerous to animals and concentrations fatal to man can occur. During storage and bacterial decomposition of the slurry causes a breakdown in organic matter and the release of gases. Recommendations are given that should help prevent accidents. (Christenbury-Iowa State)

### 0086 - A11, C1, C2, E3

**THE APPARENT DIGESTIBILITY OF ENERGY AND PROTEIN IN TOPLAN DRIED POULTRY MANURE,**
The University Department of Agriculture, Reading & Thornber Bros. Ltd., Mytholmroyd, Halifax.
B. Lowman, and D. W. Knight.
Animal Production, Vol. 11, No. 2, 1969, p. 276.

Descriptors: *Diets, *farm wastes, *poultry, organic matter, nitrogen, copper, energy, barley, sheep value.
Identifiers: *Digestibility trial, *dried poultry manure, dry matter, crude protein, starch equivalent, feed stuff.

A digestibility trial was carried out to study the apparent digestibility of five components of dried poultry manure, these being dry matter, organic matter, energy, nitrogen, and copper. Five diets were made consisting of various proportions of dried poultry manure and barley, including pure dried poultry manure and pure barley. These diets were each given to 4 castrated male sheep (20 in all), in a randomised block design for a ten-day experimental period. The apparent digestibilities of Toplan dried poultry manure were determined by actual measurement from the pure dried poultry manure diet, and by extrapolation from the other diets. The value of Toplan dried poultry manure was examined in terms of digestible crude protein, metabolizable energy and starch equivalent, and the value of the Toplan dried poultry manure as a feeding stuff for various classes of form livestock was examined in relation to the Agricultural Research Council's recommendations. (White-Iowa State)

### 0087 - C2, D3, F6

**AEROBIC DIGESTION OF CATTLE WASTE,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. D. Jones, B. A. Jones, Jr., and D. L. Day.
Transactions of the American Society of Agricultural Engineers, Vol 11, 1968, p 757-761. 18 fig, 2 tab, 4 ref.

Descriptors: *Farm wastes, *Cattle, *Biochemical oxygen demand, Chemical oxygen demand, Aerobic treatment, Sludge, Aeration, Digestion, Regression analysis, Waste treatment.
Identifiers: *Loading rates, *Aerobic digestion, Dairy cattle, Beef cattle, Volatile solids, Fixed solids, Digesters

The effectiveness was studied of the aerobic digestion process in the treatment of dairy and beef-cattle wastes. Waste from livestock being fed a high-concentrate ration was added in varying loading rates to laboratory aerobic digesters. This experiment indicates that, in the future, less emphasis should be placed on COD, VS, and FS and more on the measurement of BOD, which is a better indication of microorganism activity. BOD reductions of 70,60, and 76 percent and total VS reductions of 20,15, and 0 percent, respectively were obtained for loading rates of 125, 150, and 200 ml. from dairy cattle. Similar results were obtained using beef cattle waste. Under conditions similar to those prevailing in this study, significant reductions in biodegradable organic concentrations can be obtained. (White-Iowa State)

### 0088 - C2, E1, F1

**POULTRY MANURE DISPOSAL - IS THERE A PROBLEM,**
C. T. Riley.
Agriculture, Vol 73, 1966, p 110-112.

Descriptors: *Poultry, Costs, Nutrients, Farm wastes, Fertilizers, Value, Waste disposal.
Identifiers: Muck, Handling, Removal.

The cost is examined associated with removal of poultry manure from the house to the disposal point. It is costing the poultry farmer a shilling per bird per year to remove the muck. The fertilizer value of poultry manure should not be overlooked Farmers dispose enough manure that would be worth 160 units of nitrogen, 160 units of phosphorus and 70 units of potash if applied to a crop. (Christenbury-Iowa State)

### 0089 - A6, D2, D3, E1

**TREATMENT, USE, AND DISPOSAL OF WASTES FROM MODERN AGRICULTURE,**
Water Pollution Research Lab., Stevenage (England).
A. B. Wheatland, and B. J. Borne.
Water Pollution Control, Vol 69, No 2, p 195-[illegible], February 1970. 12 tab, 21 ref.

Descriptors: *Farm wastes, *Animal wastes, *Wastes disposal, *Waste treatment, *Waste water disposal, *Waste water treatment, *Biological treatment, *Sludge disposal, *Sludge treatment, Odor, Aerobic treatment, Incineration, Filtration, Hogs, Cattle, Poultry.
Identifiers: *Manures, *Vegetable washings.

With the trend toward larger concentrations of more animals on smaller areas of land nearer population centers, and the trend of the food industry to require washing and packing of vegetables on the farm, the farmer is faced with new problems in waste and waste water treatment and disposal. Values for quantity of excreta, solids, BOD, COD, PV, organic carbon, and total nitrogen are given for cattle, hogs, sheep, poultry, and man. Recent experimental work on animal waste treatment and disposal is discussed. The problem investigated was odor control during storage and spreading of piggery slurry by means of aeration. Problems which occurred included foaming and bulking of the slurry. The treated supernatant was to be recycled for use in washing the animal pens. Possible future methods of treating animal wastes include incineration, wet oxidation, and disposal at sea. Several analyses of vegetable washing waste waters are presented, giving volumes, pH, solids, BOD, COD, PV. Due to the variable nature of the processes involved in vegetable preparation, the actual degree of contamination of the waste water cannot be predicted accurately. Treatment includes minimizing the quantity of waste water to be treated, and primary, biological and sludge treatment and disposal. Primary treatment includes screening and sedimentation. Biological treatment can be by lagoons, aerated lagoons, oxidation ditches, extended aeration, conventional activated sludge, contact stabilization, spray irrigation, biological filtration, or high rate filtration. Sludges can be conditioned, dewatered and disposed at sea or on land. (Makela-Texas)

### 0090 - A3, C2, F6

**WILSCHWITZ RUNOFF SAMPLER,**
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
S. A. Witzel, J. T. Wilke, and F. L. Schmitz.
Transactions of the American Society of Agricultural Engineers, Vol 11, No 6, 1968, p 883, 886. 3 fig, 1 ref.

Descriptors: *Runoff, *Nutrients, *Sampling, Farm wastes, Weirs, Nitrogen, Phosphorus, Potassium, Water levels, Pollutant identification.
Identifiers: Prediction equations, Wilschwitz sampler, Water stage recorder.

The sampler was developed for the purpose of automatic collection of water samples from the flood runoff of small watersheds. It was intended to be used for measuring plant nutrient contained in runoff and not for determining suspended sediment loads. The installation of the Wilschwitz sampler in conjunction with a weir and water stage recorder provides an inexpensive means of obtaining runoff samples at various stages. The unique feature of the sampler is that it operates without auxiliary power. Details of the sampler's construction and operation are given in the article. Data gathered with this sampler are to be used in developing prediction equations relating the rates and amounts of runoff to the plant nutrients lost. If such correlations can be made, equations may be programmed to estimate amounts of nitrogen, phosphorus, potassium or other elements that may be anticipated in the surface water runoff. (White-Iowa State)

### 0091 - A6, A7

**MOISTURE INCREASES MANURE ODORS,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering
D. C. Ludington, and A. T. Sabel
Poultry Digest, September 1970, p 445-446. 1 fig, 2 tab, 1 pic.

Descriptors: *Farm wastes, *Odors, Air pollution, Poultry, Ammonia, Hydrogen sulfide, Waste dilution, Chromtography, Organic acids, Pollutant identification.
Identifiers: Masking agents, Counteractants, Deodorants, Organoleptic test.

Studies of handling livestock wastes have shown that increased dilution facilitates faster settling of manure solids; thus requiring constant agitation for efficient removal of solids. Despite some apparent handling advantages of diluted animal wastes, other considerations such as lack of odor control, quantity of material to be handled, availability of water for dilution, and certain pollution may combine to preclude handling as liquid waste. Odor strengths of animal manures have been measured using liquid dilution and vapor dilution. Agitation of liquid manure causes odors to be released and their strength to increase rapidly. A combination of gas chromotographic and organoleptic techniques have been used to determine the chemical compounds responsible for the offensive odor of accumulated liquid poultry manure. Organoleptic tests indicate that the organic acids, mercaptans and sulfides are especially important malodorous components, in addition to the odorous gases ammonia and hydrogen sulfide. An organoleptic test was developed for evaluating over 40 commercial odor control products to use with liquid waste. Masking agents and counteractants were found to be the most effective. The better procedure for controlling air pollution is to prevent the formation of odors rather than attempt to control. A manure-handling system that incorporates moisture removal apparently has some merit. (White-Iowa State)

### 0092 - A2, B1, B2, B5, C2

**SEEK DATA IN FEEDLOT RESEARCH.**
South Dakota State Univ., Brookings

South Dakota Farm and Home Research. Vol XXI, No 2, Spring 1970, p 22-27. 2 tab, 8 fig.

Descriptors: *Farm wastes, *South Dakota, *Design criteria, Cattle fertilizers, Biochemical oxygen demand, Water pollution.
Identifiers: *Feedlots, *Farm terraces, Population equivalents, Constituents.

This is a preliminary report of research aimed at coming up with information that can be used by livestock producers, governmental agencies and persons concerned with commercial feedlot design and construction. Some advantageous conditions for feedlot expansion in South Dakota are discussed. Pollution constituents in animal waste and runoff quantities are considered in making some general recommendations as to the design or layout at a feedlot. Six sketches are utilized in presenting some do's and don't's in feedlot design. (Christenbury-Iowa State)

### 0093 - A2, A4, B1

**HYDROLOGIC ASPECTS OF FEEDLOT WASTE CONTROL,**
Iowa State Water Resources Research Inst., Ames.
Richard R. Dague, Wayne L. Paulson, and Kenneth J. Kline. Iowa State Water Resources Research Institute Report No. 69-2, Iowa University, 1969. 37 p, 13 fig, 10 tab, 7 ref. OWRR Project A-022-IA.

Descriptors: *Farm wastes, *Confinement pens, *Waste treatment, *Waste disposal, Lagoons, Water pollution control, Water pollution sources.
Identifiers: Feedlot wastes, Waste management.

The hydrologic factors that require consideration when designing systems for the control of cattle feedlot runoff are considered. A discussion of several methods of controlling feedlot wastes is presented. Significant conclusions: (1) A significant reduction in water pollution from cattle feedlot run off can be accomplished by employing relatively simple and inexpensive runoff control facilities. The size of such facilities can be determined using established techniques for hydrologic and water quality analyses; (2) Using procedures similar to those described herein, it would be possible for control agencies to establish the minimum size of runoff control facilities for each region or major stream basin for each of several possible ultimate runoff disposal practices; and (3) Caution should be exercised in applying the term 'population equivalent' to cattle feedlot wastes. Any use of the term must consider the fact that the fraction of the total waste that enters water is extremely variable from one location to another and is heavily dependent upon the quantity and time variation in precipitation, the cattle density on the feedlot, and the topographic characteristics of the lot.

### 0094 - A6, C3, D3

**THE INFLUENCE OF AERATION ON THE COMPOSTING OF POULTRY MANURE-GROUND CORNCOB MIXTURES,**
Guelph Univ. (Ontario). Dept. of Microbiology.
R. G. Bell.
Journal of Agricultural Engineering Research, Vol 15, No 1, p 11-16, 1970. 5 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Aeration, *Poultry, Laboratory tests, Odor, Salmonella sp., Temperature, Depth, Microorganisms, Waste water treatment.
Identifiers: *Composting, Corncob mixtures, Canada, Microbial activity.

The influence of the rate of aeration on 1.5m colums of composting mixtures of 2 parts poultry manure and 1 part ground corncob was investigated. The results indicate that the optimum aeration rate for the production of a stable sanitary compost was 4 liters of air/$m^2$/min for every 10 cm. of composting material up to a maximum depth of about 2.4 m. A detailed discussion of the materials, methods and results is presented. (Christenbury-Iowa State)

### 0095-B2, B3, B5, C2, D3, F6

**BIO-OXIDATION OF SWINE WASTE BY THE ACTIVATED-SLUDGE PROCESS,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
Ronald E. Hermanson, Thamon E. Hazen, and Howard P. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol 12, No 3, 1969, p 342-348. 5 fig, 1 tab, 19 ref.

Descriptors: *Farm wastes, *Hogs, *Activated sludge, *Model studies, Anaerobic conditions, Farm lagoon, Regression analysis, Least squares method, Biochemical oxygen demand, Aeration, Settling basins, Nitrogen, Temperature, Effluent, Dissolved oxygen, Hydrogen ion concentration, Waste water treatment.
Identifiers: *Extended aeration, BOD-reduction efficiency, Mixed liquor, Aeration tank, Suspended solids.

The purpose of this research was to investigate the extended-aeration, activated-sludge process of swine waste treatment. Two objectives were: (1) to develop a mathematical model for the BOD-reduction efficiency of the process, and (2) to verify the model and evaluate its coefficients by conducting experiments with a laboratory-scale plant. The components of the activated-sludge treatment plant were as follows: (1) an aeration tank; (2) an aeration system; (3) a sedimentation tank; and (4) a mechanism for returning settled activated sludge to the aeration tank. The experimental model was comprised of an aeration tank and a sedimentation tank made of Plexiglas, with two galvanized sheet metal sedimentation tanks as alternates. Three capacities were required in the sedimentation section to provide suitable detention times over the range of flow rates used. The following conclusions resulted from this research. (1) Effluent from an anaerobic lagoon is sufficiently constant to be a practical influent substrate for model studies. (2) Excessive solids loss because of denitrification can be avoided by proper design of the sedimentation tank, provided the flow rate does not vary widely. (3) The mathematical model satisfactorily predicted the BOD-reduction efficiency of an extended-aeration, activated-sludge plant, as evidenced by the reasonably high multiple $r^2$ (0.92) and the low standard error (2.6 percent) of the experimental regression equation. (4) The aeration tank of an extended-aeration activated-sludge plant for the treatment of the effluent from an anaerobic swine lagoon designed according to the equation developed. (White-Iowa State)

### 0096 - A6, A7, C2

**IDENTIFICATION OF GASES IN A CONFINEMENT SWINE BUILDING ATMOSPHERE,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. A. Merkel, T. E. Hazen, and J. R. Miner.
Transactions of the American Society of Agricultural Engineers, Vol 12, No 3, 1969, p 310-313 and 315. 5 fig, 1 tab, 11 ref.

Descriptors: *Farm wastes, *Hogs, *Odor, *Gases, Confinement pens, Sulfur compounds, Ammonia, Amino acids, Porteins, Carbohydrates, Lipids, Organic acids, Solubility, Hydrogen ion concentration, Chromatography, Alcohols, Sulfides, Salting, Absorption, Condensation, Pollutant identification.
Identifiers: Acid-forming, Methane-producing, Manure storage pit, Amides, Amines, Carbonyls, Esters, Mercaptans.

In addition to the already known fixed gases, $CO_2$, CO, $H_2S$, $NH_3$, $CH_4$, etc., the environment within a confinement swine unit was found to contain a complex mixture of volatile organic intermediates. These intermediates are important in the characteristic odor resulting from the storage of manure and are suspected as being important in animal and building performance. Consideration of physical as well as organic, biochemical phenomena indicated that the important intermediate products of anaerobic manure decomposition include organic acids, amines, amides, alcohols, carbonyls and sulfides. Qualitative chemical analysis confirmed the presence of these homologous groups, except for organic acids that were decomposed upon formation by the high pH maintained within the manure storage pit. To identify individual compounds within the swing environment, concentration of the volatile gases was required. Selective absorption, liquid salting and selective condensation were each used in an effort to separate and concentrate the homologous series. Once separated, the series were subjected to chromatographic analysis for separation and identification. Physiological odor investigations have been conducted to indicate the important compounds in the specific odors in swine buildings. Work to date indicates that the major odor constituents are from the amine and sulfide groups. Further work is under way to separate these compounds. (White-Iowa State)

## 0097 - A6, B2, E1, F1

**POULTRY MANURE LAGOON DESIGN,**
California Univ., Davis. Agricultural Extension Service.
Robert A. Parsons, Fred Price, and W. C. Fairbank.
Poultry Digest, Vol 29, No 344, p 485-488, October 1970. 6 fig.

Descriptors: *Farm wastes, *Poultry, *Lagoons, *Design criteria, *Odor, Cleaning, Recirculated water, Costs, Anaerobic conditions, Anaerobic bacteria, Aerobic conditions, Aerobic bacteria, Aeration, Waste water treatment.
Identifiers: *Flushing gutter, Macerated chicken carcasses, Floating debris, V-trough, Washout system, Overload, Malfunctions, Gutter design, Thiopedea roses.

This paper deals with lagoon design criteria for poultry manure. A lagoon is a satisfactory means of poultry manure disposal. The lagoon should be used only in rural areas that are tolerant of varied but dilute odors of farm production. Overloading is about the only cause of lagoon malfunction. Size requirements, construction, flushing system, and lagoon operation are discussed. (Christenbury-Iowa State)

## 0098 - B2, C1, C2, D3

**BEEF CONFINEMENT SYSTEMS - OXIDATION DITCH,**
Minnesota Univ., Minneapolis. Dept. of Agricultural Engineering.
J. A. Moore, R. E. Larson, R. O. Hegg, and E. A. Allred.
Paper No 7331 in the Scientific Journal Series, Minnesota Agricultural Experiment Station; and Paper No 70-418, American Society of Agricultural Engineers, July 1970.

Descriptors: *Farm wastes, *Cattle, Chemical oxygen demand, Biochemical oxygen demand, Ventilation, Rotors, Foaming, Temperature, Hydrogen-ion concentration, Dissolved oxygen, Nitrogen, Ammonia, Waste water treatment.
Identifiers: *Oxidation ditch, Beef cattle, Loading rates, Solids.

The oxidation ditch has been used in Minnesota for two years for treatment of beef cattle wastes. It has been operated as a batch system with various loading rates and environmental conditions. Results are evaluated on the basis of BOD, COS, TS, TVS, pH, nitrogen, temperature of the waste, and odor and foam control. Waste management systems are employed by beef operators to meet certain objectives. These objectives may vary widely depending on such factors as management, labor requirements, climate, size and nature of operation, land availability, soil type and geologic formation and population density. No one waste system is best for all operations. Each system has advantages and disadvantages to offer for any given operation. The oxidation ditch offers the following characteristics: very low odor level, waste storage eliminates runoff, volume reduction of solids, reduction of pollution strength, concentration of some elements, necessity of continuous operation, one of more expensive treatment systems, and a buildup of solids on the bottom. Based on the results obtained from 2 1/2 years of research the authors feel that the oxidation ditch does have a place in treating beef cattle waste from confinement operations. (White-Iowa State)

## 0099 - E4, F1, F5, F6

**REMOVAL OF NITRATE BY AN ALGAL SYSTEM,**
California State Dept. of Water Resources, Fresno. San Joaquin District.
Randall L. Brown.
Environmental Protection Agency - Water Quality Office, Water Pollution Control Research Series, April, 1971, 132 p, 58 fig, 27 tab, 59 ref. EPA Program 13030 ELY.

Descriptors: Agricultural wastes, Water pollution control, *Biological treatment, *Nitrates, Treatment facilities, Algae, *Waste water treatment, *Algal control, *Aquatic weed control, California.
Identifiers: *Algae stripping, Scenedesmus, Algal growth, Algal harvesting, *San Joaquin Valley (Calif).

An algal system consisting of algae growth, harvesting and disposal was evaluated as a possible means of removing nitrate-nitrogen from subsurface agricultural drainage in the San Joaquin Valley of California. The study of this assimilatory nitrogen removal process was initiated to determine optimum conditions for growth of the algal biomass, seasonal variations in assimilation rates, and methods of harvesting and disposal of the algal product. A secondary objective of the study was to obtain preliminary cost estimates and process design. The growth studies showed that about 75 to 90 percent of the 20 mg/l influent nitrogen was assimilated by shallow (12-inch culture depth) algal cultures receiving 2 to 3 mg/l additional iron and phosphorus and a mixture of 5 percent CO2. Theoretical hydraulic detention times required for these assimilation rates varied from 5 to 16 days, depending on the time of the year. The total nitrogen removal by the algal system, assuming 95 percent removal of the algal cells, ranged from 70 to 85 percent of the influent nitrogen. The most economical and effective algal harvesting system tested was flocculation and sedimentation followed by filtration of the sediment. The algal cake from the vacuum filter, containing about 20 percent solids, was then air- or flash-dried to about 90 percent solids. The market value for this product as a protein supplement was estimated to be about $80 to $100 per ton. Miner-Iowa State)

## 0100 - A3, A5, A8, C2, E2

**ANIMAL WASTE UTILIZATION FOR POLLUTION ABATEMENT,**
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
O. E. Cross, A. P. Mazurak, and L. Chesnin.
Preprint, presented at American Society of Agricultural Engineers 1971 Winter Meeting, Chicago, Illinois, December 7-10, 1971, Paper no 71-906. 23 p, 8 fig, 9 ref. OWRR B-003-NEB (3).

Descriptors: *Farm wastes, *Cattle, Rates of application, *Furrow irrigation, Surface runoff, Groundwater movement, Nitrogen, Phosphorus, Potassium, Electrical conductivity, Crop response, Nutrients, Percolation, Sudangrass, *Path of pollutants, Pollution abatement.
Identifiers: *Feedlot wastes, Runoff losses, Surface runoff pollution.

Beef feedlot manure was applied to plots at levels of 0, 40, 120 and 260 tons dry matter per acre. The manure was disk plowed into the soil at 4, 8, and 12 inch depths. A sorghum-sudan forage was seeded at three plant populations, a 'low,' 'medium,' and 'high' density and was furrow irrigated according to standard irrigation techniques. Data was documented as to: pollutional potential of surface runoff water, pollutional contribution to underground water supply, physical and chemical changes in the soil, irrigation techniques, and crop response. The conclusions are the result of one year's test. Nitrogen and sodium displacement did not pollute the surface runoff water. The transport of potassium restricted the runoff to irrigation uses only. However, the underground water was not affected by the plots and retained its potable quality. Additional information is required to establish irrigation techniques; however, to date conclusions are: (1) the initial intake rate of water into the soil increases as higher manure loadings are applied, (2) the basic intake rate is higher on areas plowed 8 inches deep as compared to areas plowed 4 or 12 inches deep, and (3) the basic intake rate increases with time elapse after application. The application of manure increased the crop yield with the exception of the 260 ton application. (Bundy-Iowa State)

## 0101 - B3, D3, E3, F1

**MANURE MANAGEMENT - COSTS AND PRODUCT FORMS,**
Los Angeles County Agricultural Extension Service, Calif.
J. Van Dam, and C. A. Perry.
California Agriculture, Vol 22, No 12, December 1968, p 12-13. 2 tab, 2 fig.

Descriptors: *Farm wastes, *Cattle, *Marketing, *Costs, Volume, Profit, Management.
Identifiers: *Feedlots, *Processing plant, Stockpiles, Packaging, Bulk, Pulverizer, Product forms, Delivery, Removal.

A study to determine the actual cost of removal and disposal of manure from a beef feedlot in Los Angeles County was completed by the Agricultural Extension Service. Manure was prepared for marketing in three basic forms and sold under four pricing conditions. Manure processing, packaging and marketing began with the mounding of the manure in the corrals followed by its removal to a compost stockpile. Manure was allowed to cure in a compost pile at least six months before processing. The manure could then be marketed unprocessed as composted manure; marketed processed as composted bulk; and marketed processed as composted packaged manure. The combined fixed and variable costs per cubic yard amounted to 10.5 cents for the unprocessed product, 65 cents for the processed bulk and $1.88 for the packaged processed form. The weighted average price received per cubic yard was $3.80 for the packaged, $2.40 for the processed bulk, and $1.40 for the unprocessed bulk manure. A livestock feedlot operator can probably make a profit from the sale of manure. (White-Iowa State)

## 0102-A2, A4, A5, A7, B1, D3, E2, F1, F2

**POLLUTION CONTROL - FEEDLOT OPERATIONS,**
Iowa State Univ., Ames.
J. R. Miner, E. R. Baumann, T. L. Willrich, and T. E. Hazen.
Journal of the Water Pollution Control Federation, Vol 42, No 3, p 391-398, March 1970. 1 tab, 6 ref.

Descriptors: *Livestock, *Pollution abatement, Waste disposal, Reservoirs, Waste treatment, Cattle, Sewage treatment, Farm wastes, Iowa, Hogs, Poultry.
Identifiers: *Feedlot, Population equivalent.

The increase in labor cost and a shortage of personnel has caused an increase in feedlot population. The result has been a concentration of livestock waste level. Techniques of feedlot waste systems design are reported, and methods of collecting and disposing of the waste are discussed. These cattle, swine, and poultry feedlot operations are similar. Types of flooring and methods of cleaning are discussed. Treatment and disposal of the waste are commented on, including tank storage and hauling, anaerobic lagoons, aerobic lagoons, surface irrigation systems and oxidation ditches. The limiting factors of various treatments in relation to feedlot waste are reported. Zoning regulations are suggested as a partial solution to nuisance complaints which are generated by concentration of livestock in feedlots. (Hancuff-Texas)

## 0103 - A4, C2

**NITROGEN ENRICHMENT OF SURFACE WATER BY ABSORPTION OF AMMONIA VOLATILIZED FROM CATTLE FEEDLOTS,**

Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
G. L. Hutchinson, and F. G. Viets, Jr.
Science, Vol 166, No 3904, p 514-515, Oct 1969. 1 fig, 1 tab, 6 ref.

Descriptors: *Nitrogen, *Surface water, *Absorption, *Ammonia, Eutrophication, Water pollution sources, Nitrogen compounds, Nutrient cycling, Fertilization, Colorado, Precipitation (Atmospheric), Lakes, Streams.
Identifiers: *Nitrogen pollution, *Cattle feedlots, Seeley Lake (Colo), Nitrogen (Total), Nitrogen (Inorganic), Nitrogen enrichment.

A method is described for estimating nitrogen enrichment of surface waters resulting from volatilization of ammonia from cattle feedlots and its subsequent absorption into lakes and streams. Rates of ammonia absorption into dilute sulfuric acid (0.01 normal) measured near feedlots were as much as 20-fold greater than controls; estimated annual absorption (in kilograms/hectare) of 73 at site about 0.4 kilometers west of 90,000-unit feedlot can be compared with 3.9 at control site with no feedlots or irrigated fields within 3 milometers and no large feedlots or cities within 15 kilometers. Ammonia absorbed by surfaces of natural waters are apparently about half that estimated by method described. That a large feedlot can enhance nitrogen enrichment of aqueous surfaces at some distances is suggested by evidence that a fivefold increase in distance from a feedlot decreased mean ammonia absorption rate by approximately one-half. Absorption rates from smaller lots were approximately 25% of large one, but above fourfold greater than control. Authors believe that wide fluctuations in ammonia absorption rates reflect the moistness of feedlot surfaces, rapid drying enhancing volatilization and absorption. Authors conclude that such feedlots are substantial sources of nitrogen pollution for nearby surface waters. (Eichhorn-Wisconsin)

## 0104 - A2, A4, B2, F6

**MODELING FEEDLOT RUNOFF POLLUTION,**

Kansas State Univ., Manhattan. Dept. of Chemical Engineering; and Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
J. R. Miner, R. I. Lipper, and L. E. Erickson.
Transactions of the ASAE, Vol 10, No 4, p 497-501, 1967. 5 tab, 8 fig, 7 ref.

Descriptors: *Farm wastes, *Runoff, *Chemical oxygen demand, *Model-studies, Cattle, Water pollution, Hydraulic models, Discharge, Depression storage, Hydrographs, Hydrology, Rainfall intensity, Simulated rainfall.
Identifiers: *Feedlot, *Stirred tank with injection model, Concentration, Nonsurfaced lot, Concrete-surfaced lot, Soil cover complex number.

Most emphasis of this paper was on quality aspects of feedlot runoff; however a brief discussion of possible hydraulic models is given. Three concentration models are described and their ability to predict feedlot runoff water quality is shown. The three are, the stirred tank concentration model, stirred tank with injection concentration model, and the series-stirred tanks with injection concentration model. The three concentration models provided progressively better data representation as their complexity increased. Two experimental cattle feedlots especially designed for runoff investigation were used in the study. Associated with the feedlots were rainfall simulation and measuring equipment, and runoff measuring and proportional sampling facilities. One lot was concrete surfaced, the other had concrete only around feed bunks. Tempered by good judgement, feedlot models can be used to help predict organic concentration of runoff from a feedlot. When an improved hydraulic model is developed, it can be combined with either of the single, stirred tanks to provide a single feedlot model to predict overall water-pollution potential. (White-Iowa State)

## 0105 - A6, A7, C1, C2, F6

**AMMONIA AND AMINES: COMPONENTS OF SWINE-BUILDING ODOR,**

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. R. Miner, and T. E. Hazen.
Transactions of the ASAE, Vol 12, No 6, 1969. 3 p.

Descriptors: *Farm wastes, *Hogs, *Odors, *Ammonia, Atmosphere, Anerobic digestion, Proteins, Amino acids, Isolation, Chemical properties, Density, Physical properties, Absorption, Chromatography.
Identifiers: *Amines, *Odor thresholds, Concentration, Boiling points, Dissociation constants, Detection, Animal chambers.

This paper represents another step in defining the atmosphere within the swine confinement building. Ammonia and the closely related amines are known to be produced during the decomposition of both animal and vegetable proteins. Research work involving gases over decomposing manure indicate amines, ammonia and sulfur containing compounds are probably important constituents of the swine odor. The paper outlines the formation of ammonia and amines, and gives threshold odor levels for them in air. Physical and chemical properties of the different amines are given as well as methods of isolation and detection. Experimental data was taken from two animal chambers which provided substantial control over environmental conditions. The measured concentrations of ammonia were less than the threshold odor levels, indicating one of two explanations must be true: (a) Ammonia is not an important component of the hog house odor or (b) the odor producers are additive in effect and ammonia can be perceived at concentrations below its threshold when combined with other odorous compounds. Chromatographic analysis was used for detection of the different amines. (White-Iowa State)

## 0106 - B2, C2, D3, F1

**OXIDATION DITCHES FOR WASTE DISPOSAL,**

Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Donald L. Day.
International Journal Of Farm Building Resources, No 2, December 3, 1968, p 2-7. 9 fig, 9 ref.

Descriptors: *Farm wastes, *Hogs, *Biochemical oxygen demand, *Rotors, Foaming, Sludge, Effluent, Odors, Carbon dioxide, Oxygen, Depth, Dissolved oxygen, Electric power, Electric power costs, Volume, Velocity.
Identifiers: *Oxidation ditch, Population equivalent, Suspended solids, Slatted floors, Extended aeration.

The oxidation ditch is an efficient low-cost process for the treatment of municipal waste. It has several aspects that seem desirable for use in confinement livestock waste-treatment systems. The aerobic method is an odorless process with final products of water, carbon dioxide, and stable minerals. The oxidation ditch can be integrated into a self-cleaning slatted floor system. However, control of foaming is an immediate problem that must be solved before the process can be unconditionally recommended, even just for control of the odors in the gutter and when spreading on land. Operational criteria must be developed if the method is to serve for complete treatment of livestock manure, with an effluent that can be accepted by public health and water board standards. Adaptations of the oxidation ditch for the treatment of livestock manure are surely forthcoming, in view of the intense research that is in progress in the United States and abroad. However, until the current problems are resolved, the disposal of livestock manure in a manner that does not have an odor nuisance and a water pollution hazard remains a complicated problem. (White-Iowa State)

## 0107 - B3, D1, E2, E3

**DRYING POULTRY MANURE INSIDE THE POULTRY HOUSE,**

Pennsylvania State Univ., University Park. Dept. of Poultry Science.
Glenn O. Bressler.
Agricultural Engineering, Vol 51, No 3, p 136, March 1970.

Descriptors: *Farm wastes, *Poultry, *Drying, Ventillation, Waste storage.
Identifiers: *Poultry manure.

In this drying system droppings are removed at a very low moisture level, cutting weight of material to be handled by two-thirds. Eight 3000-cfm circulating fans are mounted about 22 ft. apart directly below 2 lines of water troughs that run the full length of the house. Fans are about 10 in. above the manure; air velocities over the droppings are about 250 to 750 fpm. A spike-tooth harrow is pulled daily through the accumulating droppings to stir them and to draw partially dried droppings into the high-velocity airstream. From the pit the droppings go either to truck or manure spreader or to a hammermill to be finely ground and bagged. The amount of water removed daily to prevent excess humidity and to dry the manure ranged from 6-9 gallons per hour. These results are from a flock of 3246 pullets and cockerels at 22 weeks in a 30-ft. by 100-ft. environment-controlled laying house. (White-Iowa State)

## 0108 - B5, C2

**EFFECTS OF FEED CONSUMPTION ON BIOCHEMICAL OXYGEN DEMAND OF STEER EXCRETA,**

Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
K. C. Mills, B. F. Parker, and I. J. Ross.
Transactions of the ASAE, Vol 12, No 1, 1969, p 133. 2 ref.

Descriptors: *Farm wastes, *Cattle, *Biochemical oxygen demand, Feeds, Silage, Grains, Pastures, Oxidation, Aerobic treatment, Sampling, Testing.
Identifiers: *Feed composition, Steers, Alsterberg modification, Winkler method.

The objective of the study on which the paper is based was to determine some of the effects of animal-feed composition of the rate of aerobic breakdown of animal waste. If differences in rate of aerobic breakdown occur because of feed composition, these differences should be proven by conducting biochemical oxygen demand tests on the wastes from animals on different feed. Thus excreta for BOD tests were obtained from three groups of steers being fed on all grain, grain and silage, and on pasture. The data for the pasture had much greater variability from week to week. Data on all tests are available in the original thesis and ASAE paper No. 67-930. It was concluded that the composition of animal feed will change the biochemical oxygen demand of animal excreta. This fact should be considered when designing aerobic systems for treating animal wastes. (White-Iowa State)

## 0109 - B5, C1

**SOME CAUSES OF WET POULTRY MANURE,**

Georgia Univ., Athens.
O. W. Charles.
Georgia Poultry Tips, August 1, 1970. Poultry Digest, September 1970, p 431.

Descriptors: *Farm wastes, *Poultry, *Moisture

content, Water consumption, Strain, Salts, Carbohydrates, Lipids, Proteins, Water pollution sources.
Identifiers: *Ration, Water intake, Uric acid.

Excessive moisture in poultry manure may be due to a number of factors, among which is a tendency for certain strains of birds to produce higher percentage of moisture in the fecal material than other strains. Water represents by far the largest portion of fresh poultry manure. Reports of several researchers are cited as to moisture content and differences in strain. It was found that moisture content of the droppings of low water consuming strains was only 50%, while moisture content of droppings in the high water consuming strain reached 71%. Excessive amounts of salt and a concept of balance in the ration are also discussed as causes of excessive moisture. (White-Iowa State)

## 0110 - A11, C3, F6

**ISOLATION OF SALMONELLAE FROM RENDERED BY-PRODUCTS AND POULTRY LITTER CULTURED IN ENRICHMENT MEDIA INCUBATED AT ELEVATED TEMPERATURES,**
Massachusetts Univ., Amherst. Dept. of Veterinary and Animal Sciences.
C. F. Smyser, G. H. Snoeyenbos, and Barbara McKie.
Avian Diseases, Vol 14, No 2, 1970, p 248-254. 6 tab, 13 ref. US Public Health Service Grant UI 00159-05.

Descriptors: *Poultry, *Salmonella, *Incubation, Farm wastes, Isolation, Temperature, Hydrogen ion concentration, Indicators.
Identifiers: *Enrichment media, Poultry litter, Rendered bynproducts, Plating medium.

Three enrichment media incubated at 42 plus or minus 1C were compared for isolating Salmonellae from rendered animal and marine by-products, and two of the media were compared for poultry litter. Salmonellae were recovered from 317 of the 755 rendered samples and from 203 of the 235 litter samples examined. Selenite brilliant-green sulfapyridiae (SBG sulfa), dulcitol selenite sulfapyridine (DSES), and tetrathionate brilliant-green (TBG) were equally effective. Each enrichment incubated at the elevated temperature was significantly more effective than TBG incubated at 37C for isolating salmonellae from fish meal. Essentially no difference was noted between brilliant-green (BG) agar and brilliant-green sulfadiazine (BGS) agar as a plating medium. The pH of the enrichment media at the termination of incubation could not be used as an indicator of the presence or absence of salmonellae. (White-Iowa State)

## 0111 - A6, B3, D1, F1

**UNDER-CAGE MANURE DRYING SYSTEM SOLVES ODOR PROBLEMS,**
Cloisterdale Farms, Ephrata, Pa.
Glenn H. Herr.
Farm Service Bulletin, July-August, 1970. Poultry Digest, Vol 29, No 344, p 476-479, October 1970. 4 fig.

Descriptors: *Farm wastes, *Poultry, *Odors, *Aeration, *Disposal, Economics, Aerobic conditions, Forced drying, Liquid wastes, Drying, Lagoons, Anaerobic bacteria, Costs, Waste water treatment.
Identifiers: *Stirring, Odor-causing bacteria, Semidry manure.

This paper deals with the problems and their solutions encountered by a commercial poultry farm with odors and waste management. The various systems that were tried unsuccessfully are discussed. Their solution was one developed by Dr. Glenn Bressler and co-workers at Pennsylvania State University for drying the manure. The system employs a stirring device and forced air to keep the manure aerobic. The manure is dried to one-third its original weight which has eliminated many of their disposal problems. The cost of the system is discussed. (Christenbury-Iowa State)

## 0112 - A8,B1,C2,C3,E2

**CURRENT TRENDS IN FARM WASTE DISPOSAL,**
Ministry of Agriculture, Fisheries and Food, London (England).
C. T. Riley.
Water Pollution Control, Vol 69, No 2, p 174-179, February 1970. 3 tab.

Descriptors: *Animal wastes, *Farm wastes, Cattle, Hogs, Poultry, Odor.
Identifiers: *Manure, *Population equivalents.

Much emphasis has been placed on farm waste disposal in the past five years. Reasons for this include the increased size of livestock units, nearness of units to consumers, recent legislation on river pollution control and water resources, and reaction from the public and farm workers to flies and odor associated with animal wastes. In 1967, the total volume of excreta produced by livestock in the United Kingdom was 121 million tons, with a population equivalent of 136 million. Much of this excreta is spread on the land by ranging animals. The remainder must undergo some form of disposal by man. The wastes can be handled in any of four basic methods. (1) as a solid, it is stored and spread on land once or twice a year. (2) as a semi-solid, it is spread daily. (3) as a slurry, it is handled by vacuum tanker, stored, and spread. (4) as a liquid, it is washed by water to a storage tank and spread by spray irrigation. The trend is toward solid or semi-solid handling. Factors affecting disposal method include land availability, land area, volum of excreta, soil type, crops to be grown, and climatic conditions, especially rainfall. More emphasis is now placed on planning of waste disposal before starting farm projects. Odors can be eliminated by aeration of wastes in the tanker before spreading or spraying on the land. (Makela-Texas)

## 0113 - B1, F1, F2

**LOCATING A POULTRY ENTERPRISE,**
Illinois Univ., Urbana.
S. F. Ridlen, and Hugh S. Johnson.
Illinois Monthly Poultry Suggestions, July 1970. Poultry Digest, Vol 29, No 344, p 495-496, October 1970.

Descriptors: *Locating, Farm wastes, *Poultry, Eggs, Water pollution control.
Identifiers: *Enterprise, Neighbor problems.

The chief characteristics that should be evaluated in selecting the location of a poultry enterprise are discussed. These include land cost, tax rate, water supply and topography; electricity, labor, feed supply and transportation should be considered; human population, zoning, acceptance of poultry by local people and relationship to market are important. (Christenbury-Iowa State)

## 0114 - A4,A5,A6,A7,B1,E1,E2,F1,F2

**SWINE MANURE – LIABILITY OR ASSET,**
Purdue Univ., Lafayette, Ind.
David H. Bache.
Paper presented at the American Pork Conference, Des Moines, Iowa, March 3, 4, and 5, 1970. 13 p, 10 ref.

Descriptors: *Farm wastes, *Economics, *Costs, Water pollution, Air pollution, Confinement pens, Storage capacity, Fertilizers, Swine, Cattle, Poultry, Lagoons, Odor, Oxidation, Legislation.
Identifiers: *Assets, *Liability, Slatted floors, Land disposal, Innovators penalty, Pollution abatement grants.

Swine manure is a very modest asset on crop farms and it can be a major liability on those production units with no crop land base. A literature and research review gives costs and economic value of different manure treatment systems through the past ten or fifteen years. Conclusions reached include: there is no waste disposal problem with a pasture system, there is no economically feasible alternative to the spreading of solid manures, smaller swine production units will probably find that lagoon disposal is the optimum technique for handling hog wastes, and larger production units will be shifting to the use of slatted-floors, under floor manure forage, and liquid disposal systems. Public concern and legislation is discussed. (White-Iowa State)

## 0115 - A4,A5,A6,A12,B1, C1,D3,E1,F3

**MANAGEMENT OF FARM ANIMAL WASTES.**
American Society of Agricultural Engineers, St. Joseph, Mich.
Proceedings National Symposium on Animal Waste Management, May 1966, 161 p. Michigan State University, ASAE Publication No. SP-0366.

Descriptors: *Farm wastes, *Management, *Public health, *Water pollution sources, *Livestock, *Waste disposal, *Slurries, *Lagoons, *Biological treatment, Waste storage, Physical properties, Odor, Distribution systems, Irrigation, Labor, Environmental sanitation, Sludge treatment, Incineration, Feeds.
Identifiers: Feedlot runoff, Production, High density systems, Handling, Slatted floors, Materials, Handling, Liquid manure, Equipment design, Waste management, Oxidation ditches, Composting, Kjeldahl nitrogen, Coprophagy.

The National Symposium on Animal Waste Management had three main objectives: (1) To delineate the problem of managing animal waste, (2) To evaluate our current technology in the management of our farm wastes (technology in the farm waste management was divided into methods of handling, treatment, utilization, and disposal) and (3) To stimulate and give new direction to future research in solid wastes management. Fifty-one papers were presented representing eighty-nine professionals - from industry, campus and government; from manufacturing, research, extension and regulatory agencies; as animal scientists, bacteriologists, economists, engineers, and sanitarians. The last three pages of the publication are devoted to ASAE recommendation (ASAE R292): Uniform Terminology for Rural Waste Management. (Christenbury-Iowa State)

## 0116 - B2,C1,C2,C3,D1,D3

**PHYSICAL, CHEMICAL AND BACTERIOLOGICAL PROPERTIES OF FARM WASTES (BOVINE ANIMALS),**
Michigan State Univ., East Lansing.
S. A. Witzel, E. McCoy, L. B. Polkowski, O. J. Attoe, and M. S. Nichols.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No. SP-0366, p 10-14, May 1966. 10 tab, 19 ref. USDI No. 8 RO1 SW 00042-02.

Descriptors: *Farm waste, *Waste disposal, *Cattle, *Biochemical oxygen demand, Chemical oxygen demand, Anaerobic conditions, Aerobic conditions, Hydrogen ion concentration.
Identifiers: *Lagoon flora, *Population equivalents, *Liquid manure, Liquid manure tank, Volitile solids, Plant response.

This report characterizes pollutants derived from farm animal (Bovine) waste. Wastes were collected from dairy bulls, dairy cows, and beef cattle. The wastes were analyzed for volume, suspended solids, percent BOD and COD. Further analysis show the effects of treating manure on yield and recovery of N, P, and K by corn plants. The data indicate that high concentrations of bacteria (dead or alive), volatile solids, BOD and COD are found in waste from bovine animals. The study indicated that reduction by lagoon retention, settling, aerobic or anaerobic digestion does not remove sufficient amounts of volatile solids, BOD and COD to provide safe effluent for disposal in streams. Indications are that liquid manure handling by farmers may be the most feasible approach for waste disposal. (See also W71-01992). (Christenbury-Iowa State)

## 0117 - B2

**DUCK-PROCESSING WASTE,**
Robert S. Kerr Water Research Center, Ada, Okla.
Grover L. Morris.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No. SP-0366, Michigan State University, May 1966, p 15-18. 6 tab, 6 ref.

Descriptors: *Farm wastes, *Poultry, *Coliforms, Biochemical oxygen demand, Chemical analysis.
Identifiers: *Evisceration, Long Islands ducks, Waste loads.

Objectives of the study were (a) to measure and evaluate duck processing plant waste loads and (b) to observe plant operations for possible reduction in total water use by redistribution or by reuse of certain waters presently discharged to waste after one use, or by a combination of redistribution and reuse. Study of two duck-processing plants located on Long Island provides data pertaining to water use, waste loads, and general operation. The finished product is a high-quality duck of considerable delicacy. Water use in duck-processing plants seems high when compared with water used in chicken processing. Means of reducing the amount of water used are discussed.
(Christenbury-Iowa State)

## 0118 - A10, A12

**HEALTH ASPECTS AND VECTOR CONTROL ASSOCIATED WITH ANIMAL WASTES,**
Public Health Service.
W. M. Decker, and J. H. Steele.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No. SP-0366, Michigan State University, May 1966, p 18-20. 12 ref.

Descriptors: *Farm waste, *Zoonoses, *Salmonella, *Mycobacterium, *Diseases, Water pollution sources, Public health.
Identifiers: *Pathogenic organisms, Brucella, Leptospira.

The diseases contracted by man from animals are discussed. Q fever, Anthrax, Salmonellosis, Tuberculosis, Brucellosis, and Leptospirosis are the major diseases examined. The source of the disease and the means by which man contracts the diseases are presented. Other pathogenic organisms arising from animals are mentioned.
(Christenbury-Iowa State)

## 0119 - A10, B1

**BIOLOGICAL INTERRELATIONSHIPS BETWEEN FECES AND FLIE[illegible],**
California Univ., Berkeley.
John R. Anderson.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No. SP-0366, Michigan State University, May 1966, p 20-23. 35 ref.

Descriptors: *Farm wastes, *Domestic wastes, Confinement pens, Livestock.
Identifiers: *Filth flies, *Livestock-husbandry operations, *Fly populations, Livestock production methods, High-density confinement.

This report discusses the effects on fly populations as affected by changes in livestock production methods. Field research has indicated that the foremost cause for the prodigious number of flies today is the recent widespread occurence of low-area, high-density concentrations of animals in all phases of livestock-husbandry operations. Although recent changes in livestock husbandry have created serious fly problems, the possibilities for constructively managing manure to avoid or reduce the production of flies under today's low-area, high-density confinement of animals appear much better than with previous technologies.
(Christenbury-Iowa State)

## 0120 - A2, A4, B2, C2, C3

**STORMWATER RUNOFF FROM CATTLE FEEDLOTS,**
Kansas State Univ., Manhattan.
J. R. Miner, L. R. Fina, J. W. Funk, R. I. Lipper, and G. H. Larson.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 23-27. 8 tab, 9 fig, 11 ref.

Descriptors: *Water pollution, *Detention reservoirs, *Farm waste, Waste storage, Nitrogen compounds, Organic waste, Rainfall intensity, Coliforms, Streptococcus, Chemical oxygen demand, Bacteria.
Identifiers: Rainfall duration, Feedlot runoff, Bacteriological activity, Kjeldahl nitrogen, Pollution potential.

Runoff characteristics from two experimental cattle feedlots were studied. Runoff was high-strength organic waste containing large quantities of nitrogenous compounds. The nitrogenous matter was being transformed continuously by bacteriological activity. More organic matter and Kjeldahl nitrogen were found in the runoff (a) with low-intensity rainfall, (b) with moist conditions preceding rainfall, and (c) during warm weather. Cattle feedlot runoff was a concentrated source of bacteria that normally are used to characterize water quality. Hydrologic characteristics of feedlot waste contribute to their stream-pollution potential. A detention pond seems feasible to prevent some of the slugging nature of the material. Diverting all rainfall not falling directly on the feedlot surface around the entire facility and maintaining lots so their litter remains as dry as possible were helpful in minimizing stream pollution potential.
(Christenbury-Iowa State)

## 0121 - B5, C1

**PHYSICAL PROPERTIES OF ANIMAL MANURES ASSOCIATED WITH HANDLING,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 27-32. 5 tab, 8 fig, 11 ref.

Descriptors: *Physical properties, Bulk density, *Farm wastes, Liquid wastes, Particle size, *Poultry, *Cattle.
Identifiers: Volatile solids, Fixed solids, *Flowability, Freezing point, *Production.

This paper is concerned with various physical properties of chicken and dairy cow manure that have a relationship to handling. The properties are considered mainly from the standpoint of both fresh and diluted manure. The information reported was obtained from analysis concerned with the physical properties of animal manures and represents a summary of those properties which are specifically related to handling. These properties are: (a) basic physical composition, (b) particle density and bulk density, (c) production, (d) particle size and distribution, (e) dilution, (f) settling rate, (g) suspended and dissolved solids, (h) flowability, and (i) freezing point. (Christenbury-Iowa State)

## 0122 - A6, B1, B4, E2, E3

**METHODS OF HANDLING POULTRY-WASTE MATERIAL,**
Cornell Univ., Ithaca, N.Y. Dept. of Poultry Science.
C. E. Ostrander.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 32-33.

Descriptors: *Poultry, *Farm wastes, Waste storage, Waste disposal, Odors.
Identifiers: *Handling, High-density systems, Processing, Methods, Collecting.

This paper reports on manure handling methods employed in high-density poultry operations. Operations include: collecting, removal, storing, loading, spreading, processing and disposal. (See (Christenbury-Iowa State)

## 0123 - B2, E1, F1

**PUMPING MANURE SLURRIES,**
California Univ., Davis. Dept. of Agricultural Engineering.
S. A. Hart, J. A. Moore, and W. F. Hale.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 34-38. 22 fig, 2 tab, 5 ref. Public Health Research Grant EF-265.

Descriptors: *Pump testing, *Slurries, *Farm wastes, *Waste disposal, *Performance, Waste dilution, Efficiencies, Contrifugal pumps.
Identifiers: Handling, Capacity, Positive displacement, Diaphragm, Input horsepower, Selection criteria.

The purpose of this report was to analyze the performance characteristics of the different kinds of pumps under various conditions. Five pumps, representing centrifugal, positive displacement, and diaphragm types were tested. A pump was always tested with water first. Fresh manure was then mixed with the water to form a slurry. This was kept well mixed both by recirculation by the pump and by continuous mixing of the storage tank. Some 300 individual runs were made in testing the five pumps with three manures at various speeds. Dilution was more important than kind of pump, thin slurries being most satisfactory. Practical and economic conditions are discussed relating to pump selection. (Christenbury-Iowa State)

## 0124 - B2, E2

**ENGINEERING PROBLEMS IN YEAR-ROUND DISTRIBUTION OF WASTE WATER,**
Pennsylvania State Univ., University Park, Pa. Dept. of Agricultural Engineering.
E. A. Mye[illegible].
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 38-41. 1 tab, 2 fig, 6 ref.

Descriptors: *Sprinkling, *Distribution systems, *Sewage disposal, Farm wastes, Freezing, Winter, Distribution patterns.
Identifiers: Deflector stationary sprinklers, Year-round irrigation.

This paper presents some of the problems encoun-

tered which may be considered in the design, installation, and operation of irrigation systems for animal-waste disposal. The system used to distribute waste water at Penn State is first explained briefly. Then the problems encountered are discussed under the headings: pumping, pipe system, and irrigation heads.
(Christenbury-Iowa State)

### 0125 - A11, B1, B5

**SLOPING FLOORS FOR BEEF-CATTLE FEEDLOTS,**
California Univ., Davis.
S. R. Morrison, V. E. Mendel, and T. E. Bond.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 41-43. 3 tab, 4 fig, 3 ref.

Descriptors: *Cattle, *Farm wastes, Confinement pens, Performance, Disposal.
Identifiers: *Slatted floor, *Sloping floor, *Feedlots, Weight gains, Cattle behavior, Feed efficiency.

Limited tests on sloping floors for cattle feedlots indicate that slopes up to 7 deg do not depress weight gains or feed efficiency. A slope of about 5 deg is sufficient for removal of most of the manure, but unless some flushing arrangement is employed, manure will build up near the feed bunk. Stalls have little value in preventing this build-up. A slat-covered pit at the lower end of the slope allows manure to move freely off the floor and serves as a satisfactory storage. (Christenbury-Iowa State)

### 0126 - B1

**MATERIALS HANDLING AND LABOR IN FREE-STALL AND LOOSE HOUSING,**
Purdue Univ., Lafayette, Ind.
W. E. Schmisseur, C. M. Brown, Jr., J. L. Albright, W. M. Dillon, and A. C. Dale.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 43-45. 3 tab, 17 ref.

Descriptors: *Farm wastes, *Cattle, Disposal, Labor.
Identifiers: *Materials handling, *Free-stall, *Loose housing, Bedding.

In the winter and spring of 1964-65 Purdue University conducted two 6-month studies in Lafayette and Cuzco, Indiana, comparing free-stall to loose housing. For one free-stall comparison, 20 stalls were place in one-third of the area of each of two pole-type barns. The remaining areas were used for loose housing. Ninety cows were divided into four individual lots. Each free-stall unit housed 20 cows, with 25 cows in loose housing. All four lots were treated and handled similarly. Straw was used as bedding. Daily work sheets showing time used to bed the cows, scrape alleys, pounds of bedding used, and the pounds of manure removed daily were kept on all groups. Two pole-type barns were also used in the other free-stall comparison. One barn was used for loose housing; the other contained 32 free stalls; 26 animals were housed in each barn. Sawdust was used to bed all animals for half of the experiment; straw was used for the rest of the experiment. (Christenbury-Iowa State)

### 0127 - A12, B1, F3

**CATTLE-MANURE HANDLING AND DISPOSAL SYSTEMS ON THE WEST COAST,**
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
E. H. Davis.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 45-47. 3 ref.

Descriptors: Cattle, *Farm wastes, *Farm management, Project planning, Environmental sanitation.
Identifiers: Loafing sheds, Liquid manure, *Health authorities, Alleyways, Holding tanks.

Stall housing, an acceptable practice, produces manure which requires special handling. The method of handling and disposing of manure in a sanitary manner depends on climatic conditions and management practices. Disposal of animal wastes is part of the livestock enterprise and should be charged to this operation. As animals and people get closer together in heavily populated areas, disposal of animal wastes in a sanitary manner becomes increasingly important. Close working relationships with state health departments is essential. Additional research is needed concerning lagoon, nitrate contamination of underground water supplies, grinding units for processing beef and dairy manures, and agitation equipment for large holding tanks. (Christenbury-Iowa State)

### 0128 - B1, D3

**MACERATION FOR DISPOSAL OF DEAD POULTRY,**
California Univ., Davis. Dept. of Agricultural Engineering.
J. A. Moore, and W. C. Fairbank.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 47-49. 2 fig, 2 ref.

Descriptors: *Farm wastes, Disposal, Farm lagoons, Septic tanks, *Waste disposal, *Poultry, Equipment slurries.
Identifiers: *Macerator, Composting, Thin bed drying, *Equipment design.

The development of a macerator for dead poultry is reported. Several initial designs were investigated. Combining all the findings of the preliminary investigation in the final design of the second chopper-type macerator has led to the development of a satisfactory dead-bird macerator. Systems for disposal of the macerated poultry are discussed and evaluated. Slurry systems, lagoons, heated septic tanks, artificial composting, and thin bed drying were judged to be satisfactory for disposing fo the macerated poultry.
(Christenbury-Iowa State)

### 0129 - B1, B5, D1

**WATER METABOLISM STUDIES MAY ASSIST WITH WASTE DISPOSAL,**
Texas A and M Univ., College Station. Dept. of Poultry Science.
J. H. Quisenberry, D. D. Malik, and Ramon Ibarbia.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 49-51. 10 tab.

Descriptors: *Farm wastes, *Poultry, Waste disposal, Odor, Clays, Bentonite, Genetics, Confinement pens, Eggs diets.
Identifiers: Waste management, Water excretion, Drippings, Laying bird.

For many poultry operations, attempts to solve the waste-management problems can best be accomplished by concentrating on methods of obtaining dry or drying the droppings to a manageable level. Three methods have been tested and were reported in this paper. These are: (a) use of splashboards under cage operations, (b) genetic selection for low water excretors. Each of these has its appropriate place in bird management and should be used by poultrymen as their specific needs require. (Christenbury-Iowa State)

### 0130 - A6, A10, B2, E2

**DISPOSAL OF POULTRY MANURE BY PLOW-FURROW-COVER METHOD,**
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Agricultural Engineering.
Charles H. Reed.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 52-53. 1 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Waste disposal, Odor, Slurries, Furrows, Soil disposal fields.
Identifiers: *Waste management, *Plow cover, Liquid manure, Flies.

The disposal of liquid manure by the plow-furrow-cover technique appears to be an excellent conservation method. The upper soil layer is used as the disposal medium; there is no opportunity for flies to breed or even feed. In a closed handling system there are no detectable odors. With this method from 1 to 2 in. of slurry is deposited in a plowed furrow 6 to 8 in. deep. Immediately after deposition, a single-bottom plow covers the manure, making the next furrow; this can be done in one or two operations. Depositing and completely covering 2 in. of slurry, equivalent to 225 tons per acre, has been very successful. This paper describes the development of the method, the initial disposal programs, and the proposed experimental program to determine the maximum rate of disposal on a limited land area. (Christenbury- Iowa State)

### 0131 - A8, B2, D3, E1

**DISPOSAL OF HOUSEHOLD WASTES IN THE SOIL,**
Southern Illinois Univ., Carbondale; and Ohio State Univ., Columbus.
J. H. Jones, and G. S. Taylor.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 53-55. 1 tab, 2 fig, 5 ref.

Descriptors: *Farm wastes, *Septic tanks, *Sewage disposal, *Conductivity, Soil disposal fields, Sewers, Construction, Absorption, Rural areas.
Identifiers: *Soil absorption, *Soil clogging, Household wastes.

Generally the most satisfactory method of disposing of human excreta and household wastes in rural areas is the septic tank soil sbsorption system. While studies show that this is a safe system of household wastes disposal, many systems are malfunctioning; a high percentage of these failures is due to soil absorption difficulties. Thus the utility of the system depends on the size of the absorption field, the waste load, soil conditions, and the construction and installation of the absorption field. This paper discussed the criteria that should be used when designing a septic-tank system. The factors affecting the satisfactory operation of the system are presented. Construction and installation practices are examined. Conditions affecting soil clogging are presented along with conductivity vs cumulative outflow graphs.
(Christenbury-Iowa State)

### 0132 - A6, B5, D3

**REQUIREMENTS FOR MICROBIAL REDUCTION OF FARM ANIMAL WASTES,**
South Dakota State Univ., Brookings. Dept. of Bacteriology.
Edward C. Berry.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 56-58. 2 tab, 1 fig, 13 ref.

Descriptors: *Farm wastes, *Lagoons, *Biodegradation, *Sewage bacteria, Odor, Anaerobic conditions, Aerobic conditions, E. coli, Bac-

teria, Fungi, Actinomycetes, Protozoa, Algae.
Identifiers: *Chemical environment, *Physical environment, Phage, Fermentor, Facultative, Microaerophilic, Inoculation.

The cardinal principle on which all sanitation reduction work is based is to provide an environment in which the micro-organisms can bring about conversion of undesirable material to a non-offensive and stable state in the shortest possible time. To bring this about it is necessary to consider (a) the wastes we want reduced and their end products and (b) the organisms that we want to perform this chore for us. The micro-organisms involved in manure reduction are to be found in the following groups: (a) bacteria (aerobic, anaerobic, microaerophilic, facultative or obligate), (b) fungi, (c) actinomycete, (d) protozoa, (e) algae, and (f) phage. Each organism finds its optimum environment under fairly restricted environmental conditions. This paper gives examples of the most common micro-organisms and the effect the environment has on their activity.
(Christenbury-Iowa State)

### 0133 - B2, C2, D3
**AEROBIC TREATMENT OF SWINE WASTE,**
Illinois Univ., Urbana.
R. L. Irgens, and D. L. Day.
Laboratory study is reported in more detail in 'Journal of Agricultural Engineering Research', 11: (1) 1-10, 1966, R. L. Irgens and D. L. Day. Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 58-60. 8 fig, 3 tab.

Descriptors: *Farm waste, *Aerobic treatment, *Aeration, Biochemical oxygen demand, Chemical oxygen demand, Oxidation.
Identifiers: Swine waste, Waste collection pits, Slotted-floor, Oxidation ditch.

From the results of these tests, it was calculated that for aerobic stabilization of the waste, about 6 cu. ft. of tank volume per pig would be required and approximately 1.2 lb 02 per lb of BOD (0.65 lb BOD per 125-lb pig per day), or 2500 cu. ft. of air pen lb of BOD at 3 per cent efficiency of oxygen utilization. The aerobic process for treating swine waste is odor-free and does not attract flies. The only gas that is produced is carbon dioxide which to a large extent will remain in solution as bicarbonate. The organic matter that is not oxidized to carbon dioxide and water is converted to stable solids, which are easily dewatered and dried on a sand bed. The effluent has a low BOD and is free from ammonia. It seemed feasible to develop an oxidation ditch inside a swine production bulding utilizing self-cleaning slatted floors.
(Christenbury-Iowa State)

### 0134 - B2, D1, D3, E3
**OPERATING CHARACTERISTICS OF TWO AEROBIC-ANAEROBIC DAIRY MANURE TREATMENT SYSTEMS,**
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering; and New Holland Machine Co., Pa.
N. W. Webster, and J. T. Clayton.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No. SP-0366, Michigan State University, May 1966, p 61-65. 2 tab, 14 fig, 20 ref. USDI water research act of 1964 (Public Law 88-379).

Descriptors: *Farm wastes, *Anaerobic conditions, *Aerobic conditions, *Aeration, Sedimentation, Dissolved oxygen, Biochemical oxygen demand.
Identifiers: *Dairy manure, Aerators, Aeration tanks, Sedimentation tanks, Systems, Volatile solids.

Two aerobic waste-treatment systems were designed and tested for use in treating dairy manure. The systems were combinations of aeration and settlement for the purpose of reducing the pollution capabilities of the waste and to make it possible to use the treated effluent for transporting the fresh waste. The system utilizing anaerobic primary settlement and secondary aeration system was selected as the best suited for agricultural use. A system using primary aeration with secondary settlement did not operate satisfactorily.
(Christenbury-Iowa State)

### 0135 - B2, C1, C2, C3, D3
**TRICKLING FILTERS AS A DAIRY-MANURE STABILIZATION COMPONENT,**
Massachusetts Univ, Amherst.
D. O. Bridgham, and J. T. Clayton.
Manage Farm Animal Wastes, Amer Soc Agr Eng, St. Joseph, Mich, pp 66-68, 1966. 3 p, 6 fig, 3 tab, 9 ref. OWRR Project A-009-MASS.

Descriptors: *Trickling filters, Filters, *Waste treatment, Sewage effluents, *Farm wastes, Effluents, Settling Basins, *Cattle, *Dairy industry, Wastes, Biochemical oxygen demand, Pollution abatement.

Trickling filters are an effective means of reducing the polluting qualities of dairy manure and a possible means of treating effluent for discharge or recirculation. Loading rate and waste temperature have a great effect on the quality of the effluent. Nine points were plotted for this experiment and labeled according to average BOD of the effluent under respective conditions. Assuming a linear relationship between points, a topograph was drawn for various qualities of effluent. With bubbling aeration, a 1000-lb cow would require 334 cu ft of storage and treatment volume for 6 months of operation between sludge removals. An aeration tank, 134 cu ft in volume, was operated at 95 deg F. The estimated size for 70 deg F operation was 200 cu ft. Experiments support Webster's value for sizing primary sedimentation tanks of 200 cu ft per cow for biannual sludge removal. Test results show the volume of trickling filter required per cow to meet specific temperatures and effluent qualities. Experiments suggest a sedimentation tank volume of about 114 cu ft per cow instead of the 248 cu ft actually used. Therefore, a trickling filter system would require from 346 to 391 cu ft of tanks per cow to produce an effluent BOD of 200 ppm.

### 0136 - A11, B3, D3
**ON-SITE COMPOSTING OF POULTRY MANURE,**
Auburn Univ., Ala. Dept. of Agricultural Engineering.
J. R. Howes.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 68-69.

Descriptors: *Farm wastes, *Poultry, *Aerobic conditions, Microorganisms, Peat, Cellulose, Aerobic treatment.
Identifiers: *Composting, Fecal material, *Litter, Heat of composting, *Litterlife.

Although composting dates back to antiquity, the composting of poultry litter in situ is new. A culture of 46 species of micro-organisms was mixed into a base of peat and various minerals. This active mixture was spread at the rate of 1/2 lb. per sq. ft. on poultry litter that was at least 6 in. deep and contained an appropriate balance of cellulose and fecal material. Water used to clean the house interior was added to the litter and then mechanically mixed to initiate aerobic action. After heat of composting had subsided, birds were placed on the litter. This process is relatively inexpensive. It overcomes problems associated with obtaining and disposing of litter; provides odor and fly-free environments; permits birds to be safely replaced on the same litter shortly after diseased stock has been removed or the houses flooded; permits humidification of poultry houses; keeps dust to a minimum and enables house interiors to be washed, thus increasing sanitation and equipment efficiency.
(Christenbury - Iowa State)

### 0137 - A6, B2, D3
**PRIMARY TREATMENT OF SWINE WASTES BY LAGOONING,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
T. L. Willrich.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 70-74. 2 fig, 7 tab, 14 ref. U. S. Public Health Research Grant EF00410.

Descriptors: *Farm wastes, *Anaerobic conditions, *Design criteria, *Performance, Lagoons, Anaerobic bacteria, Chromatium, Rhodothece, Odor, Gases, Sludge.
Identifiers: *Sludge accumulation, *Swine wastes, *Waste treatment lagoons, *Anaerobic lagoons, Micro lagoons, Lagoon feeding, Gas production, Odor production.

A brief history of lagooning at Iowa State University is presented. The design and problems associated with operation of the lagoon are presented. Data was taken over a period of 8 years to arrive at recommendations for construction of lagoons. Factors discussed include: detention times and sludge accumulations, loading rates, lagoon performance, gas production, odor production, micro-lagooning, lagoon feeding, and design criteria. The recommended design criteria are: (1) For anaerobic lagoons which will receive fairly uniform and frequent (one-a-week or less) loadings: allow a minimum of 1 cu. ft. of lagoon water volume per pound of total animal weight confined in a hog-finishing building, plus additional lagoon volume for sludge storage. (2) For lagoons which will recieve non-uniform and intermittent loading: allow a minimum of two cu. ft. of lagoon water volume per pound of total animal weight confined in a hog-finishing building, plus additional lagoon volume for sludge storage.
(Christenbury-Iowa State)

### 0138 - A6, B2, C2, D3
**DESIGN CRITERIA FOR ANAEROBIC LAGOONS FOR SWINE MANURE DISPOSAL,**
Nebraska State Dept. of Health, Lincoln.
David R. Curtis.
Proceedings National Symposiun on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 75-80. 5 fig, 5 tab.

Descriptors: *Farm wastes, *Anaerobic conditions, *Chemical oxygen demand, *Biochemical oxygen demand, *Odor, *Hydrogen ion concentration, Lagoons, Temperature, Oxidation-reduction potential, Alkalinity.
Identifiers: *Kjeldahl nitrogen, *Volatile acids, *Swine waste, Anaerobic lagoons.

On-site investigations were conducted at 10 selected lagoons to confirm data collected through questionnaires and to observe the actual operation. Data collected included: Number of swine served, sketch of the plan and elevation views, chemical data on samples collected at various times during the study, and a typical cross section of the lagoons showing how solids have accumulated. The temperatures in the lagoons ranged from 70 to 80 F, with temperatures of 75 F and above more prevalent. Oxidation reduction potential (ORP) data indicated that anaerobic conditions were present at all times in the lagoons. Chemical analyses have proved to be effective diagonostic in-

struments in evaluating the probable cause of objectional odors from lagoon installations. The determinations of greatest significance were pH, Kjeldahl nitrogen, volatile acids, alkalinity, BOD and COD. Design criteria for hog lagoon installations for Nebraska are given. Operational procedures are outlined that should improve the chances for successful lagoon operations.
(Christenbury-Iowa State)

### 0139 - A2, B2, C2, D3

**CATTLE-MANURE TREATMENT TECHNIQUES,**
Kansas Univ., Lawrence. Dept. of Civil Engineering.
R. W. Agnew, and R. C. Loehr.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 81-84. 1 fig, 5 tab, 10 ref.

Descriptors: *Farm wastes, *Lagoons, *Anaerobic digestion, *Aeration, Activated sludge, Solid wastes, Runoff, Chemical oxygen demand, Biochemical oxygen demand, Laboratory tests, Alkalinity.
Identifiers: *Waste characteristics, *Polishing unit, *Anaerobic lagoons, *Aeration systems, Settled solids, Solids handling, Solids disposal, Runoff control, Volatile acids, Kjeldahl nitrogen.

The characteristics of commercial lagooning operations were discussed. It was pointed out that there was a need for extensive planning in the design and operation of lagoons. It was suggested that a combination of an anaerobic lagoon and an aeration unit may be most practical for most installations. Data was presented and discussed concerning the characteristics of anaerobic lagoons, aeration systems, and the settled solids. A potential treatment facility was proposed and discussed as to the cost, colids handling, solids disposal, efficiency, and runoff control. (Christenbury-Iowa State)

### 0140 - D1, D2

**DEWATERING CHICKEN MANURES BY VACUUM FILTRATION,**
Clarkson Coll. of Technology, Potsdam, N.Y., and New York State Dept. of Health, Albany.
E. A. Cassell, A. F. Warner, and G. B. Jacobs.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 85-91. 5 tab, 9 fig, 32 ref. N.Y. State Dept. of Health (Contract No. C-18768).

Descriptors: *Farm wastes, *Sludge treatment, *Poultry, *Dewatering, Laboratory tests, Sewage sludge, Filtration, Municipal wastes.
Identifiers: *Sludge conditioners, *Vacuum filtration, Chemical-sludge conditioners, Conditioner dosage, Liquid requirements, Solids demand.

The sludge conditioning and vacuum filtration characteristics of sewage sludges and chicken manures were found to be vastly different. Most of the sewage sludges were dewatered with FeC13, FeC13 and lime conbinations, cationic polyelectrolyte, and non-ionic polyelectrolyte sludge conditioners. None of these effectively promoted the dewatering of chicken manures. On the other hand, the anionic polyelectrolyte effectively dewatered chicken manure, but not the sewage sludges. The anionic polyelectrolyte can reduce the specific resistance of chicken manures by as much as a factor of 15 and produce filter cakes with as high as 25 percent total solids. (Christenbury-Iowa State)

### 0141 - D1, F6

**REMOVAL OF MOISTURE FROM POULTRY WASTE BY ELECTRO-OSMOSIS (PART I),**
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
Otis E. Cross.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 91-93. 7 fig.

Descriptors: *Farm wastes, *Dewatering, *Electro-osmosis, Laboratory tests, Cathodes, Poultry.
Identifiers: Moisture distribution, Expelling water.

This investigation was designed to determine the effectiveness of expelling water from poultry excrement by the electro-osmosis phenomena. Three factors were selected as being the most critical: amount of electric current, time, and distance between electrodes. Twelve plastic tubes were placed in a horizontal position. Each tube was 2 in. ID and 65 cm. long. The piston-type anode was carbon and maintained constant pressure upon the excrement sample by means of a weighted-lever arrangement. The cathode was a 1 mm. copper screen. The tests were conducted with three sample lengths: 40, 25, and 10 cm. The electro-osmosis phenomena produced a 57 percent decrease in moisture content. The amount of expelled water was a function of current flow, time, length of sample, and moisture content of the sample.
(Christenbury-Iowa State)

### 0142 - D1, F1, F6

**REMOVAL OF MOISTURE FROM POULTRY WASTE BY ELECTRO-OSMOSIS (PART 2),**
Michigan State University, East Lansing. Dept. of Agricultural Engineering.
F. V. Nurnburger, C. J. Mackson, and J. Davidson.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 93-95. 7 fig.

Descriptors: *Farm wastes, *Electro-osmosis, *Dewatering, Poultry.
Identifiers: *Joule heating, *Gravity flow, Current flow.

This investigation was undertaken to study the effects of various electrode materials on the liquid expelled from chicken excrement by the process of electro-osmosis. It utilized the effects of joule heating and gravity flow. The results from using 5, 10, 15, and 20 v d-c were that 20 v d-c gave the best results. Of the three materials used, stainless steel gave the best performance, copper was the poorest, and steel was intermediate. The maximum moisture-content reduction was 4.8 percent wb based on 22 hr. of operation at 20 v. This was not sufficient to reach a pelletable level from the initial value of 80 percent wb. The cost of the electric energy used was 12.7 cent per gallon of liquid removed based on the rate of 2 cent per Kw-hr.
(Christenbury-Iowa State)

### 0143 - A7, C1, D2, F1

**DESTRUCTION OF CHICKEN MANURE BY INCINERATION,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel, and D. C. Ludington.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 95-98 2 tab, 4 fig, 12 ref. N.Y. State Department of Health (Contract No C18965).

Descriptors: *Farm wastes, *Incineration, Poultry, Laboratory tests, Heat balance, Natural resources.
Identifiers: *Combustion, *Solid fuels, Volatile solids, Mass balance, Fixed carbon, Ash, Heat of combustion, High heat value, Low heat value, Energy balance.

The volatile solids in chicken manure represents considerable energy. Incineration is a process which utilizes this energy for destruction of the organic portion of the manure. The application of existing combustion theory to the incineration of chicken manure is difficult beacuse of lack of basic property information and the variability of the material. The incineration process is very dependent on the moisture content of the manure. A laboratory incinerator has been constructed to investigate the incineration process. Initial trials of the incinerator have been restricted to partially dried manure. Considerable information has been obtained. Future application of incineration will depend on cost factors and possible air pollution hazards. A mass and heat balance for a typical incineration trial is given in an Appendix to the paper. (Christenbury-Iowa State)

### 0144 - A4, A12, C3, D1

**TREATMENT OF DUCKWASTES AND THEIR EFFECTS ON WATER QUALITY,**
Virginia State Water Control Board, Richmond.
R. V. Davis, C. E. Cooley, and A. V. Hadder.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 98-105, 10 tab, 7 ref.

Descriptors: *Farm wastes, *Coliforms, *Poultry, *Oysters, *Water quality, Salmonella, Biochemical oxygen demand, Environmental effects, Settling basins.
Identifiers: *Rappahannock River, Pilot pond, Barnhardt Farms, Inc., MPN (Most probable number), Raw wastes, Duck run.

Early in 1963 a six-month study was undertaken to determine the effect of coliform organisms in the treated wastes from two duck farms on water quality in an oyster-producing and recreational area of the Rappahannock River near Urbanna, Virginia. Before the treatment facilities were installed, water quality in the area was questionable for recreation purposes and was restricted for direct marketing of shellfish. Treatment consists of alternately used earthen settling basins for removing solids, followed by 4-day retention earthen basins. These remove essentially all settleable solids and reduce the most probable number of coliform organisms per 100 m l. by 90 to 95 percent. On the basis of data collected from the river, restrictions from the public oyster beds were lifted. Satisfactory recreational water quality now exists throughout the area, except very near the discharges.
(Christenbury-Iowa State)

### 0145 - A11, C2, D2, E3

**VALUE OF BROILER LITTER AS FEED FOR RUMINANTS,**
Virginia Polytechnic Inst., Blacksburg; Cornell Univ., Ithaca, N.Y.; and Kansas State Univ., Manhattan.
J. P. Fontenot, A. N. Bhattachanya, C. L. Drake, and W. H. McClure.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 105-108. 7 tab, 11 ref.

Descriptors: *Farm wastes, *Poultry, *Sheep, *Cattle, *Feeds, Proteins, Metabolism, Ruminants, Feeding rates.
Identifiers: Nutritive value, Broiler litter, Digestible protein, Digestible energy, Metabolizable energy, Total digestible nutrients, Carcass grade, Rate of gain.

Information has been presented concerning the nutritive value of broiler litter for ruminants. The litter samples analyzed contained an average of 32 percent crude protein, dry basis. In autoclaved litter, true protein accounted for 45 percent of the total nitrogen. In metabolism trials with wethers, 25 and 50 percent autoclaved peanut-hull and wood-shaving broiler litters replaced corresponding amounts of a corn-hay ration. There were no sig-

nificant differences in digestible protein, digestible energy, metabolizable energy, and TDN content between kinds and levels of litter. Average values were 22.7 percent, 2440 kcal per kg, 2181 kcal per kg, and 59.8 percent, respectively. It was found in fattening trials that rate of gain and carcass grade were not significantly different for beef steers fed mixtures containing 25 percent ground peanut-hull or wood-shaving broiler litter than for those fed a conventional fattening mixture.
(Christenbury-Iowa State)

## 0146 - A11, C2, E3

**UTILIZATION OF ANIMAL WASTE AS FEED FOR RUMINANTS,**
Auburn Univ., Ala. Dept. of Animal Science.
Aw. Brady Anthony.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 109-112. 13 tab, 23 ref.

Descriptors: *Farm wastes, *Cattle, *Chemical analysis, Feeds, Silage, Nutrients, Amino acids, Vitamins.
Identifiers: *Feedlot manure, *Steers, *Digestion coefficients, *Average daily gain, Manure, Carcass data.

Analysis of feedlot manure showed it to be a valuable source of vitamins and amino acids. Washed manure was mixed with a concentrated feed and successfully fed to steers. When unwashed manure was combined with a concentrated mixture or with silage and fed to steers, animal gain and feed efficiency were not improved. Fresh feedlot manure proved to be a valuable ration component when it was either washed or autoclaved. Fresh feedlot manure was blended with coastal bermudagrass hay to make a palatable and nutritious low-moisture silage. (Christenbury-Iowa State)

## 0147 - A11, E2, F5

**COPROPHAGY AND USE OF ANIMAL WASTE IN LIVESTOCK FEEDS,**
Texas Tech. Univ., Lubbock.
R. M. Durham.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 112-114. 6 tab.

Descriptors: *Farm wastes, *Feeds, *Livestock, Poultry, Cattle, Catfishes, Sheep, Swine, Eggs.
Identifiers: *Coprophagy, *All-concentrate ration, Feedlot steers, Digestion coefficient.

This paper reports observations of coprophagy in cattle consuming an all-concentrate ration and the feeding of rations containing manure from these cattle to poultry, cattle, swine and catfish. The all-concentrate ration was composed of 89% ground milo, 10% cottonseed meal and 1% vitamin-mineral supplement. The manure was ground in a hammer mill without prior drying and mixed with other ration ingredients for feeding. Coprophagy has been observed in cattle consuming limited quantities of the all-concentrate ration. All-concentrate cattle manure has been successfully fed to growing pullets and laying hens. The all-concentrate manure has been fed to feedlot steers with generally favorable results to limit feed consumption. Catfish can make rapid gains on feedlot manure if care is taken to prevent oxygen depletion. (Christenbury-Iowa State)

## 0148 - B1, C2, D3, E1, E4, F5

**ROLE OF THE RENDERER IN THE USE AND DISPOSAL OF ANIMAL WASTES,**
Triangle E By-Products Co., Harrisonburg, Va.
E. L. Foerster, Sr.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 114-117.

Descriptors: *Farm wastes, Poultry, Cattle, Chemical analysis, Economics, Disposal, Equipment, Digestion tanks, Nutrients.
Identifiers: *Rendering, *Fallen stock, Protein content, Coprophagy.

Mr. Foerster gives a general history of the rendering industry in the United States. He explains the role of the industry in disposing of fallen animals. He gives an analysis for a typical product from a rendering plant. Some data is presented concerning the economics of the rendering process. Through cooperation, the rendering plant can provide a useful and efficient service in disposing of fallen stock. (Christenbury-Iowa State)

## 0149 - B2, D3, F5

**EVALUATING ADAPTABILITY OF PASTURE GRASSES TO HYDROPONIC CULTURE AND THEIR ABILITY TO ACT AS CHEMICAL FILTERS,**
Agricultural Research Service, Beltsville, Md.; and Maryland Univ., College Park.
Harry J. Eby.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 117-120. 6 fig.

Descriptors: *Farm wastes, *Hydroponics, *Effluents, Nutrients, Municipal wastes, Lagoons, Grasses, Aquatic environment, Root development, Light penetration.
Identifiers: Plant-nutrient removal percentage, Fertilizer value, Nutrient extraction potential, Surface area.

The possibility of using hydroponics as a means of removing nutrients from sewage-treatment plants and lagoons is discussed. Several grasses were studied with rye and tall fescue showing the most promise. Data is presented in graph form showing the plant-nutrient removal percentages. Two appendices are given. Appendix I shows the projected yield capabilities of the various forage grasses with the nutrient-extraction potential based on laboratory-scale sampling. Appendix II shows the method for computing the size of the hydroponic system required for any given volume of effluent. (Christenbury-Iowa State)

## 0150 - A6, B1, E2, F1, F2

**PROBLEMS OF CATTLE FEEDING IN ARIZONA AS RELATED TO ANIMAL-WASTE MANAGEMENT,**
Arizona Univ., Tucson. Dept. of Agricultural Economics.
Thomas M. Stubblefield.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 120-122. 11 ref.

Descriptors: *Farm wastes, *Cattle, *Legal aspects, Relocation, Area development, Odor, Arizona.
Identifiers: *Cowtowns, *Feedlots, Metropolitan areas, Manure.

Problems associated with locating large numbers of cattle near metropolitan areas are discussed. The particular problems with large feeders in Arizona and their solutions are presented. Feedlot manure selling for as high as $5 per ton in the 1940's now is a liability costing $1 to $1.50 per ton to remove. It has been advantageous for the feedlots to relocate near farming areas for more efficient disposal of the manure. To circumvent problems with residential areas, 'cowtowns' are being developed. (Christenbury-Iowa State)

## 0151 - B2, E1, E2, F1

**ECONOMIC EVALUATION OF LIQUID-MANURE DISPOSAL FOR CONFINEMENT FINISHING OF HOGS,**
Illinois Univ., Urbana. Dept. of Agricultural Economics.
Richard P. Kesler.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 122-125. 6 tab, 2 ref.

Descriptors: *Farm wastes, *Swine, *Disposal, *Economics, *Annual cost, Lagoons, Storage capacity, Size, Nutrients, Ultimate disposal, Liquid wastes.
Identifiers: Manure, Total lagooning, Hauling and spreading, Recovery rate, Fertilizer nutrients, Salvaged nutrients.

Manure is a valuable by-product of the hog industry. This manure must be disposed of on the land to obtain its inherent value. Factors that should be considered in choosing a manure disposal system are (a) amount of manure that is produced, (b) fertility content of the manure and its value as a replacement for commercial fertilizer, (c) disposal costs of each system, and (d) availability of cropland on which to spread the manure. An extensive economic analysis of three disposal systems is presented: (I) Total hauling and spreading, (II) Total lagooning, and (III) Partial hauling and spreading and lagooning. Three sizes of hog operation were considered in the comparison: 500, 1500, and 2500 head. (Christenbury-Iowa State)

## 0152 - B2, D3, E2, F1

**ECONOMICS OF LIQUID-MANURE DISPOSAL FROM CONFINED LIVESTOCK,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Economics.
W. H. M. Morris.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 126-131. 6 tab, 1 fig, 16 ref.

Descriptors: *Farm wastes, *Cost analysis, *Disposal, *Value, *Nutrients, Chemical oxygen demand, Biochemical oxygen demand, Cost comparison, Economic feasibility, Economics, Anaerobic conditions, Aerobic treatment, Liquid wastes, Irrigation.
Identifiers: *Production model, Losses in storage, Value of manure, Utilization, Oxidation ditches.

Some of the problems in estimating the costs and returns from handling manure have been discussed. Removal of the manure from the livestock production areas has not been discussed. In general, the scale and efficiency of the operation and prevention of dilution of the manure determine if the manure can be spread in the fields at a cost equal to or less than the value of the nutrients used by the crop. Aerobic and anaerobic treatment of manure in special low-cost facilities designed for use on the farm seem to be practical solutions. No profitable method of industrial utilization of livestock manure can be forseen. (Christenbury-Iowa State)

## 0153 - C2, E3, F1

**POULTRY MANURE MARKETING,**
Pennsylvania State Univ., University Park.
Herbert C. Jordan.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 132-133.

Descriptors: *Farm wastes, *Marketing techniques, Fertilizers, Poultry analysis, Value, Economics.
Identifiers: *Bagging, *Processing.

A survey was conducted between 1961 and 1963 concerning marketing poultry manure. Information concerning the following topics was collected: General, Bagging Manure, Processing, Supplemental Mixture, and Marketing. Cost associated with bagging and minimum analysis (nitrogen, phosphoric acid, potash) is given for bags ranging from 2.5 to 80 pounds per bag. A summary of the data is presented pointed out that fresh manure is worth about $5 a ton to the soil ($20 per ton on a dry weight basis). Poultry manure used as an organic soil conditioner is and perhaps will remain the greatest and most common use of poultry manure. (Christenbury-Iowa State)

### 0154 - B1, D3, E1

**FARM-WASTE MANAGEMENT TRENDS IN NORTHERN EUROPE,**
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
E. P. Allred.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 133-136. 1 fig.

Descriptors: *Farm wastes, *Disposal, Equipment.
Identifiers: *Northern Europe, Family-size farm, Oxidation ditches, Disposal practices.

Farmers throughout most of northern Europe are faced with many of the same waste-disposal problems as those confronting American farmers. Methods and equipment used for waste disposal are discussed with emphasis on the 'family-size' farm. Those individuals working with oxidation ditches are quite optimistic with its performance. When one compares rural waste-disposal practices in Europe with those in America, there are noticeable differences in both equipment and methods. Surprisingly the greatest differences occur, however, in the people themselves and their attitude toward rural waste disposal. (Christenbury-Iowa State)

### 0155 - A8, B2, B5, C2, E2

**PLANT RESPONSE TO MANURE NUTRIENTS AND PROCESSING OF ORGANIC WASTES,**
Forschungsanstalt fuer Landwirtschaft, Brunswick (West Germany).
Cord Tietjen.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 136-140. 3 tab, 9 fig, 12 ref.

Descriptors: *Farm wastes, *Liquid wastes, *Nutrients, Urine, Nitrogen cattle, Swine, Fertilizers.
Identifiers: *Gulle, *Plant response, Plant nutrients, Manuring, Feces.

To produce gulle (liquid manure) from cattle feces and to apply it for manuring, the grassland has for a long time been the common way of disposal of animal waste in the Alpine foreland. New labor-saving barn arrangements, tools and implements promote the practice of gulle utilization both for grassland and cropland. It was learned by field and pot experiments that gulle can exert a strong influence on plant growth. The physiological efficiency of gulle nitrogen is several times higher than that of nitrogen in common barnyard manures. Range of variation is great depending on gulle processing and composition. Quality of manure, its contents and ratio of plant nutrients depend on kind of animals, individual properties of animals, feeding, dilution by water or other additives, barn arrangement, collection and storage facilities. It is recommended that animal excrement be processed to a standardized manure - a full gulle that can be characterized by its ratio of plant nutrients. (Christenbury-Iowa State)

### 0156 - D3, F1

**BIOLOGICAL TREATMENT OF ANIMAL WASTES,**
Netherlands Rijkswaterstaat, Arnhem.
Henri M. J. Scheltinga.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 140-143. 7 tab, 3 fig, 10 ref.

Descriptors: *Farm wastes, *Activated sludge, *Biological treatment, Swine, Laboratory tests, Nitrogen, Cost, Biochemical oxygen demand.
Identifiers: *Nitrogen balance, *Holland, *Oxidation ditch, Nitrification, Bio-industries.

This paper discussed treatment of farm wastes in Holland. Chemical and mechanical treatment alone have not proven satisfactory. Laboratory and full scale treatment experiments have been conducted. Aeration, anaerobic decomposition, activated sludge treatment, and oxidation ditch experiments have been performed. Foaming has been experienced in some tests. Nitrification and nitrogen balance for farm wastes are discussed. The cost associated with the treatment facilities were considered. (Christenbury-Iowa State)

### 0157 - A4, A5, A7, B1, C2, C3, D3, E1, E2,F1, F2

**ANIMAL WASTE MANAGEMENT.**
Cornell Univ., Ithaca, N.Y.

R. C. Loehr, Editor. In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, January 13-15, 1969. 414 p.

Descriptors: *Farm wastes, *Hogs, *Cattle, *Water pollution, *Air pollution, Soil contamination, Rates of application, Poultry, Sheep, Biochemical oxygen demand, Chemical oxygen demand, Dissolved oxygen, Hydrogen ion concentration, Oxidation Lagoons, Lagoons, Aeration, Soils, Moisture content, Fertilizers, Nitrogen, Phosphorus, Potash, Economics, Legal aspects, Legislation, Water quality act, Water table, Odors, Rotors, Aerobic conditions, Anaerobic conditions, Digestion, Antibiotics, Irrigation, Oxygen, Rotations, Hydrology, *Waste water treatment.
Identifiers: *Oxidation ditch, Land disposal, *Feedlots, *Confinement, Population equivalent, Slatted floors, Decomposition.

The increase in high density confined animal production operations in the past decade has led to a number of environmental quality problems, such as air and water pollution. The 1969 Conference attempted to bring knowledgeable individuals from many disciplines together to mutually discuss various aspects and potential solutions to the animal waste management problem. Forty-six papers, reports, and speeches are presented in the proceedings. Such diverse topics as hydrology, economics, odor measurement, lagooning, aerobic digestion, and land disposal are presented. Research and studies in many fields are reported. (White-Iowa State)

### 0158 - A4, A5, F1

**REFLECTIONS ON POLLUTION CONTROL,**
Zurn Industries, Inc., Washington, D.C.
Leon W. Weinberger.
In: Animal Waste Management, Proceedings, Cornell University, Conference on Agricultural Waste Management, p 1-3, 1969.

Descriptors: *Farm wastes, *Water pollution, *Water quality, *Cost-benefit ratio, Water pollution control, Environment, Waste water treatment.
Identifiers: *National policy, National misconception.

Dr. Weinberger expresses three personal viewpoints dealing with national policy on water pollution control, cost benefit analysis in water pollution control, and finally comments on the greatest myth or misconception in water pollution control. This national misconception being that we do not know how to solve the problems of water pollution control. Dr. Weinberger asks everyone to speak out and be heard on the way that you want to have our environment. (White-Iowa State)

### 0159 - B1, F2, F3

**ENVIRONMENTAL POLLUTION--NOW AND IN THE YEARS AHEAD,**
Office of Science and Technology, Washington, D.C.
Donald R. King.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 4-8, 1969.

Descriptors: *Farm wastes, *Environment, Legal aspects, Research and development, Design standards, Waste treatment, Waste disposal.
Identifiers: *Agricultural Pollution, Resource conservation, Waste uses, Land planning.

The report points out several avenues that warrant research attention; among them the following: (1) The potential benefits to control which may result from changing the character of animal wastes. (2) Information is needed on present control approaches to make them more generally applicable. (3) The tremendous volume of animal wastes produced necessitates the development and application of new and more effective treatment and disposal methods. (4) Additional attention to potential uses for animal wastes would be desirable. (5) Land use planning also warrants emphasis. (6) Additional information also will be needed on the relationships of wastes to agricultural production which can be used to assist in establishing standards. (White-Iowa State)

### 0160 - A4, A5, F2

**EFFECTS OF WATER QUALITY STANDARDS ON THE REQUIREMENTS FOR TREATMENT OF ANIMAL WASTES,**
Federal Water Pollution Control Administration, Washington, D.C.
Harold Bernard.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 9-16. 1 tab, 2 fig, 5 ref.

Descriptors: *Farm wastes, *Legal aspects, *Water quality act, Biochemical oxygen demand, Chemical oxygen demand, *Water quality standards, Municipal wastes, Industrial wastes, Waste water treatment.
Identifiers: FWPCA, Animal feedlot, *Disposal requirements, *Waste treatment standards, Environmental backlash, Interstate waters.

Changes that have taken place in water quality standards are discussed. The purpose of the standards is to: (a) provide an engineering base for the design of waste treatment works by municipalities and industries without uncertainties in waste disposal requirements in interstate waters. (b) Serve as a clear public (local) policy statement on the use or uses to which specific segments of interstate waters may be put after due consideration of all the factors delineated above. The effect of these changes in standards is discussed with relation to the treatment of animal wastes. Future municipal B.O.D. loads and their subsequent treatment costs are brought out. It is mentioned that the FWPCA is interested in receiving proposals to demonstrate new or unique treatment and control techniques for animal wastes, especially in conjunction with an on-going operation. Only with the cooperation and leadership of the industry itself can techniques be developed to meet the various water quality standards and enable the industry a growth unimpeded by any environmental backlash. (White-Iowa State)

### 0161 - A6, B1, F3

**THE CHALLENGE OF ANIMAL WASTE MANAGEMENT,**
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 17-22. 5 ref.

Descriptors: *Farm wastes, Odors, Waste water treatment.
Identifiers: *Animal production, *Waste management, Environmental quality, Interrelationships of animal production, Study and research.

There is a woeful lack of understanding of the interrelationships between various aspects of animal production and waste management. It is to this point and to these relationships that this paper is addressed. The long term approach for animal production must be based upon not only optimal production of the product, but also on management of the entire production scheme such that it is consistent with the maintenance of acceptable environmental quality not only to the animals, and to the producers, but to society as a whole. The problem of animal waste management is actually many problems. It consists of technical, economic, social, educational, and perhaps above all, a communications problem. The talents of individuals from many disciplines are needed to produce better solutions to the problem. We need to initiate more studies that will take an overview of the animal production operation, feasible waste management systems, and their interrelationships. These studies should develop information that can be used as predictive and/or decision making tools to anticipate and minimize problems that may result. Herein lies the greatest challenge of animal waste management. (White-Iowa State)

### 0162 - A8,C2,D2,D3,E2,F3

**THEORY AND FUTURE OUTLOOK OF ANIMAL WASTE TREATMENT IN CANADA AND THE UNITED STATES,**
Toronto Univ (Ontario). Dept. of Civil Engineering.
P. H. Jones.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 23-36. 2 tab, 27 ref.

Descriptors: *Farm wastes, *Biochemical oxygen demand, *Biological treatment, *Oxygen, Water pollution, Nitrogen, Odors, Carbon, Waste water treatment, Aeration, Aerobic treatment, Anaerobic digestion.
Identifiers: Pollution potential, Waste characteristics, Integrated farming, Aerobic composting.

This paper presents some of today's theories on waste treatment and their effectiveness, both socially and physically. The paper tells of the pollution potential and characteristics of animal waste, as well as some of the waste treatment objectives. Theoretical formulas are presented for the introduction of oxygen into an aqueous system, and the reduction of BOD. Potential solutions to the waste treatment problem are listed and summarized as follows: integrated farming, anaerobic holding, aerobic systems, complete treatment, anaerobic digestion, drying and incineration, and aerobic composting. Research needs are given, as well as a look to the future for what may be possible. (White-Iowa State)

### 0163 - A6, B2, C2, D3

**DESIGN PARAMETERS FOR THE STABILIZATION OF HIGHLY ORGANIC MANURE SLURRIES BY AERATION,**
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.
Albert F. Vickers, and Emil J. Genetelli.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 37-49. 7 fig, 6 tab, 11 ref.

Descriptors: *Farm wastes, *Poultry, *Aerobic treatment, *Biochemical oxygen demand, Dissolved oxygen odor, Waste water treatment.
Identifiers: Aerobic stabilization, Manure slurry, Ultimate disposal, Loading parameter, Suspended solids.

It has been determined in this research that aerobic stabilization basins are not suitable for the complete treatment of slurries of poultry manure. However, the aerobic stabilization basins do provide satisfactory pretreatment prior to ultimate disposal. This treatment provides sufficient stabilization of the manure to eliminate nuisance problems when ultimately disposed of on land. The critical loading parameter determined in this bench scale system is a volume loading of 60 cubic feet of aeration basin per pound of applied BOD in the manure slurry. The average BOD reduction in the unsettled effluent was 87% with an average solids destruction of 53%. Foaming difficulties were encountered after the critical loading parameter determined was exceeded. (White-Iowa State)

### 0164 - A6,B1,C2,D3,E2,E3

**SWINE WASTES, CHARACTERIZATION AND ANAEROBIC DIGESTION,**
Kansas Agricultural Experiment Station, Manhattan.
Lawrence A. Schmid, and Ralph I. Lipper.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 50-57. 4 tab, 2 fig, 3 ref.

Descriptors: *Farm wastes, *Anaerobic digestion, Swine, Biochemical oxygen demand, Chemical oxygen demand, Methane, Odor, Waste water treatment.
Identifiers: *Digester, Waste digestion, Feed ration.

Laboratory and field tests were undertaken to show the effectiveness of anaerobic digestion as a possible solution to swine waste treatment. The following conclusions are made from the study: (1) The waste characteristics can be related to pounds of waste per unit pound of live weight. (2) If organic removal is the desired objective, it can best be done by solids removal from the fresh wastes resulting in COD reductions of 90%. (3) Mixing is required in the anaerobic digestion phase to disperse the fresh waste. (4) Normally, the efficiency of anaerobic treatment can be increased by increasing the solids retention time. (5) Results have shown that conventional anaerobic digestion cannot be practiced on raw undiluted hog wastes which include the urine. (6) Digestion only for liquifaction does not require the close environmental control required to stimulate growth of methane bacteria. (7) Design for the objective of waste liquifaction for the purpose of reuse as flushing water, ultimate disposal on land, and ease of handling can be one answer to the problem of handling and treatment of wastes from confinement feeding of swine. (White-Iowa State)

### 0165 - B3, B5, C1, C2, D3

**AEROBIC DECOMPOSITION OF SOLID WASTES FROM CATTLE FEEDLOTS,**
Texas Technological Coll., Lubbock. Dept. of Civil Engineering.
D. M. Wells, R. C. Albin, W. Grub, and R. Z. Wheaton.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 58-62. 4 fig.
Descriptors: *Farm wastes, *Moisture content, Cattle, Temperature, Nitrogen, Phosphorus, Waste water treatment.
Identifiers: *Aerobic stabilization, *Composting process.

This is a progress report on research being conducted on the aerobic stabilization of solid beef feedlot wastes and is concerned with the composting process and with the effect of feed, management, and climate on waste stabilization. Two general areas were reported in the paper, one concerned with composting in open air piles and the other with composting in a specially built drum type digester. Forty per cent reductions in volume and 20% losses in dry matter were noted. The most rapid rate of stabilization seemingly takes place during the first few days of the process, with a steady decrease in the rate of stabilization occurring with time. (White-Iowa State)

### 0166 - B1, C2, D3, F6

**ANALYSIS FOR OXYGEN TRANSFER COEFFICIENTS IN ROTOR AERATION SYSTEMS,**
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
John J. Kolega, Gordon L. Nelson, and Quintin B. Graves.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 63-75. 9 fig, 4 tab, 13 ref.

Descriptors: *Farm wastes, *Equations, Oxygen, Dissolved oxygen, Oxygenation, *Model studies, Waste water treatment.
Identifiers: *Rotor aerator, *Oxidation ditch, Oxygen transfer.

The laboratory method described presents a technique for use in the engineering design and analysis of a horizontal rotor aerator system in livestock waste management. This procedure can be used to obtain quantitative prediction equations to estimate the oxygen transfer coefficients for a selected range of operating conditions. Once the prediction equation for a given system is developed, it can be further used to evaluate new applications provided the parameters fall within the range of the predicted equation developed. An equation for estimating the oxygen transfer coefficients per revolution of rotor was obtained with a model rotor aerator using distilled water as the liquid. Rotor aerator performance curves illustrating how the prediction equation can be used in livestock waste system design and management were also developed. (White-Iowa State)

### 0167 - A6,B4,C2,D3,E2,F6

**AEROBIC STORAGE OF DAIRY CATTLE MANURE,**
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
Don E. Bloodgood, and C. M. Robson.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 76-80. 2 tab, 1 fig, 4 ref.

Descriptors: *Farm wastes, Cattle, Aeration, Temperature, Odor, Chemical oxygen demand, Waste water treatment.
Identifiers: Dairy cattle, Loading rates, Kjeldahl nitrogen, Degradation, Volatile solids.

Laboratory tests with seven liter, aerated containers were performed in 4C and 24C rooms. Loading rate of 60, 80, 100, and 120 grams of wet raw dairy manure per day were used at both temperatures. Conclusions were made from the results of the experiment as follows. (1) The amount of leading does not influence the degree of degradation that takes place. (2) The tests indicate a decrease in volatile solids of 20 per cent at 4C and

42 per cent at 24C. (3) Appreciable amounts of material with a COD are removed in the aerobic storage process. (4) The Kjeldahl nitrogen concentration of material remaining after aerobic storage is higher after the storage period. (5) Foaming is a real problem in the aerobic storage of manure from dairy cattle. (6) Aerobic storage of manure from dairy cattle has promise of minimizing the odor problem encountered in the spreading of unaerated material after storage. (White-Iowa State)

### 0168 - B2, C1, C2, D1, D3, E1, E2, F6

**AEROBIC DIGESTION OF DILUTED ANIMAL MANURE IN CLOSED SYSTEMS - TEMPORARY EXPEDIENT OR LONG RANGE SOLUTION,**
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
J. T. Clayton, and T. H. Feng.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 81-87. 6 fig, 1 ref.

Descriptors: *Farm wastes, *Aerobic treatment, *Anaerobic digestion, *Effluents, Cattle, Biochemical oxygen demand, Nitrates, Hydrogen ion concentration, Waste water treatment.
Identifiers: *Sedimentation tanks, *Degradation, Volatile solids.

The pilot scale manure treatment system studied was an adapted composite of two aerobic-anaerobic dairy manure treatment systems. It was designed to process the waste of one mature dairy cow, together with the water necessary to flush the manure from the barn. The system consisted of a 2000 gallon primary sedimentation tank, a 1000 gallon aeration tank, and a 200 gallon final sedimentation tank. The effluent was collected and analyzed at three different points in the closed system. Graphs of total solids, volatile solids, pH, BOD, and nitrate content versus time are given for the three effluent collection points. The overall objective was to design a system the effluent from which could be used as a flushing and transport medium for subsequent cleanings of a dairy cow housing facility, or be discharged into a water course. (White-Iowa State)

### 0169-A11, B5, C2, D2, E3

**INFLUENCE OF CHEMICAL TREATMENTS UPON DIGESTIBILITY OF RUMINANT FECES,**
Agricultural Research Service, Beltsville, Md. Animal Husbandry Research Div.
L. W. Smith, H. K. Goering, and C. H. Gordon.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 88-97. 10 tab, 11 ref.

Descriptors: *Farm wastes, *Cattle, *Digestion, Sheep, Orchardgrass, Alfalfa, Ruminants, Waste water treatment.
Identifiers: Sodium hydroxide, Sodium peroxide, In vitro fermentation, Chemical treatment.

Sodium hydroxide and sodium peroxide treatment of orchardgrass and alfalfa cow feces resulted in large decreases in the cell wall (CW), cellulose, hemicellulose, and lignin contents. Treatment with sodium chlorite changed composition little except for a large reduction in lignin content. True CW digestibility was increased several fold by each treatment as measured by an in vitro fermentation technique. Corn silage rations containing 25% of the total dry matter (DM) as either untreated or 3% sodium peroxide treated orchardgrass feces were consumed equally well as an all corn silage ration by sheep. Lower intake was observed for a corn silage ration which contained 50% similarly treated feces also on a dry matter basis. Digestibility coefficients for the various components of the feces portion of the rations were calculated by difference. Addition of 3% sodium peroxide to feces increased average DM, 29; nitrogen, 25; CW, 55; cellulose, 41; and hemicellulose, 90 digestibility units over that of the untreated feces. Neither concentration nor molar ratios of ruminal volatile fatty acids changed due to the inclusion of treated or untreated feces in rations for sheep. (White-Iowa State)

### 0170 - A11, C2, D2, E3

**THE VALUE OF HYDROLYZED AND DRIED POULTRY WASTE AS A FEED FOR RUMINANT ANIMALS,**
Pennsylvania State Univ., University Park.
T. A. Long, J. W. Bratzler, and D. E. H. Frear.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 98-104. 12 tab.

Descriptors: *Farm wastes, *Feeds, *Nitrogen, Poultry, Cattle, Sheep, Waste water treatment.
Identifiers: *Hydrolyzed poultry waste, Rations, Feedlot performance, Digestion coefficient, Carcass characteristics.

Information was presented concerning the value of heat treated poultry waste as a source of nutrient for ruminant animals. In a metabolism trial, whethers were fed a semi-purified ration in which the nitrogen was supplied by hydrolized poultry waste, cooked poultry waste, or soybean oil meal. The digestion coefficients for crude protein differed significantly (PA.05) between all rations. Nitrogen excreted in the feces was significantly lower for the soybean oil meal ration than for the poultry waste ration. No other significant differences were observed. It was found in a fattening trial with steers that rate of gain, feed efficiency, and carcass grade were not significantly different for beef steers fed rations in which the supplemental nitrogen was supplied as soy bean oil meal, hydrolized poultry waste or dried poultry waste. Rate of gain was higher (PA.05) for the steers fed the ration containing urea. The treated poultry waste rations were readily consumed by the steers and no undesirable effect on carcass characteristics were found. (White-Iowa State)

### 0171 - A11, D3, E3

**CATTLE MANURE: RE-USE THROUGH WASTELAGE FEEDING,**
Alabama Agricultural Experiment Station, Auburn.
W. Brady Anthony.
In: Animal waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 105-113. 9 tab, 1 fig, 10 ref.

Descriptors: *Farm wastes, *Cattle, Feeds, Performances, Waste water treatment.
Identifiers: *Wastelage, Yeast fermentation.

Manure collected daily from a concrete floor of a pen housing steers was blended with a fattening feed in the ratio of 2:3. The wastelage system was developed for more flexibility. Wastelage is the combining of fresh manure with ground grass hay in the ratio of 57:43 with storage in a silo until fed. Five conclusions were drawn from the study. (a) Fresh feedlot manure can be mixed with concentrate and fed successfully to cattle with a considerable saving in feed used per unit of beef produced. (b) Wastelage represents a flexible system of removing manure daily, blending it with hay, and storing as silage. (c) Elimination of pollution from steer feedlots can be obtained through use of the wastelage plan. (d) Yeast can be produced on fluidized and aerated manure. About 68% of manure dry matter appears recoverable in the yeast fermentation product. (e) Feedlot manure properly handled is a valuable product for conversion to an animal feed. (White-Iowa State)

### 0172 - B2, E2

**SPECIFICATIONS FOR EQUIPMENT FOR LIQUID MANURE DISPOSAL BY THE PLOW-FURROW-COVER METHOD,**
Rutgers - The State Univ., New Brnuswick, N.J. Dept. of Agricultural Engineering.
Charles H. Reed.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 114-119. 8 fig.

Descriptors: *Slurries, *Disposal, Farm wastes, Poultry, Waste water disposal.
Identifiers: *Plow-furrow-cover, Utilization.

A condensation is presented of experimental work that was done on land application of poultry manure slurries. Several pieces of equipment and different operations were looked at. Most incorporated a single bottom 16 in. plow operating 7 in. to 8 in. deep. Manure was deposited in the furrow and then covered. Tank trailers and commercial liquid manure tanks were used to transport and funnel the slurry into the furrow. General performance specifications for plow-furrow-cover equipment is included. (White-Iowa State)

### 0173 - A8, C2, E2

**USE OF POULTRY MANURE FOR CORRECTION OF Zn and Fe DEFICIENCIES IN PLANTS,**
Colorado State Univ., Fort Collins. Dept. of Agronomy.
B. F. Miller, W. L. Lindsay, and A. A. Parso.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 120-123. 2 tab, 6 ref.

Descriptors: *Farm wastes, *Fertilizers, Poultry, Iron, *Corn, Waste water treatment.
Identifiers: *Micronutrient deficiency, Zinc.

A greenhouse study was conducted with corn on a soil deficient in available Zn and Fe. Fifteen fertilizer combinations including N,P, Zn, Fe, poultry manure and poultry manure ash were used. Adequate K was supplied by the soil. The results of this study are interpreted as showing that poultry manure is beneficial for the correction of Zn and Fe deficiencies. This benefit is supplementary to its value as an NPK fertilizer. Furthermore, the organic fraction of poultry manure is important in rendering Zn and Fe more available to plants. This beneficial effect is greater in the case of Fe than Zn, but it is significant in both cases. The findings of this study support the hypothesis that manure and other organic wastes may either supply or give rise to natural chelating agents that aid in the solubilization of insoluble micronutrient elements in soil and thereby render them more available to plants. (White-Iowa State)

### 0174 - A5, A6, A7, A8, B2, C2, E2

**THE NITROGEN PROBLEM IN THE LAND DISPOSAL OF LIQUID MANURE,**
Guelph Univ. (Ontario). Dept. of Soil Science.
L. R. Webber, and T. H. Lane.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 124-130. 3 tab, 1 fig, 13 ref.

Descriptors: *Farm wastes, *Nitrogen, *Groundwater, Nitrates, Water pollution sources, Waste water treatment.
Identifiers: *Nitrogen pollution, Crop utilization, Pollution control.

Segments of research are presented that lead to the preparation of guidelines outlining the cropland requirements for the utilization and disposal of the nitrogenous compounds in liquid manures. The objective in land spreading was two-fold: (a) to apply the waste at such rates that the practice will be nitrogen utilization for crop production at optimum use-efficiency; and (b) to apply the waste at such rates that the practice becomes primarily one of disposal while not contributing to environmental pollution (air, water, soil). Tables show the different rates of application and how the nitrogen is removed. Recommendations are given as to how much land is required for crop utilization and pollution control for different livestock operations. (White-Iowa State)

### 0175 - A4, A5, B2, B4, C1, C2, C3, E2

**STATUS REPORT ON WATER POLLUTION CONTROL FACILITIES FOR FARM ANIMAL WASTES IN THE PROVINCE OF ONTARIO,**
A. R. Townshend, K. A. Reichert, and J. H. Nodwell.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 131-149. 14 tab, 5 fig, 9 ref.

Descriptors: *Farm wastes, *Water pollution control, Cattle, Hogs, Poultry, Lagoons, Waste water treatment.
Identifiers: *Population equivalent, *Confinement housing, Pollution potential, Concentrations, Land disposal, Oxidation ditch.

Farm animal waste problems of the agricultural industry in Ontario are concentrated on the liquid manure water pollution control facilities presently serving swine, beef cattle, dairy cattle, and poultry confinement housing operations. It is concluded that based on present technology and economics, the approach to animal waste disposal in Ontario for the forseeable future should continue to be one of storage and land disposal rather than treatment and effluent discharge to water courses. The status report estimates the pollution potential of farm animal wastes; outlines the present methods of handling liquid manure from confinement operations; tabulates animal waste characteristics, loadings, and population equivalents; gives field data and experiences on typical water pollution control facilities; and concludes with guidelines on the selection, design, and operation of farm waste systems. (White-Iowa State)

### 0176 - A4, B2, B4, C2, D1, D3, E2, F1

**DISPOSAL OF DAIRY CATTLE WASTES BY AERATED LAGOONS AND IRRIGATION,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
A. C. Dale, J. R. Ogilvie, A. C. Chang, and M. P. Douglas.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 150-159. 11 fig.

Descriptors: *Farm wastes, *Oxidation lagoon, *Sprinkler irrigation, Biochemical oxygen demand, Chemical oxidation demand, Oxidation-reduction potential, Odor, Irrigation, Waste water treatment.
Identifiers: Dairy cattle.

The system studied the aerobic type using a lagoon for storage and treatment but relying solely on sunlight and algae for oxygen. A mechanical surface aerator was used to supply oxygen and for mixing. An overhead sprinkler irrigation system was used in conjunction with the treatment lagoon. The liquid was applied to cropland (grassland) beside the lagoon. Perameters measured included BOD, COD, total solids, volatile solids, pH, and total gallons of influent and effluent; temperature, DO, pH and oxidation-reduction potential of the mixed liquor; distribution of effluent by irrigation; and odor associated with the area. Tentative conclusions were reached as a result of work to date: (a) The system is odorless. (b) The system provides a place to dispose of wastes at all times. (c) Nutrients are saved and are returned to the land. (d) With proper operation, runoff into streams and ditches is minimized. (e) Pollutional characteristics of all wastes are greatly lowered. (f) Cost of installation and operation do not appear to be excessive. (g) A relatively small amount of labor is required. (White-Iowa State)

### 0177 - A6, B2, C2, D3

**FIELD TESTS OF OXIDATION DITCHES IN CONFINEMENT SWINE BUILDINGS,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Don D. Jones, Donald L. Day, and James G. Converse.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 160-171. 15 fig, 1 ref.

Descriptors: *Farm wastes, *Hogs, *Rotors, Oxygen demand, Biochemical oxygen demand, Chemical oxygen demand, Waste water treatment.
Identifiers: *Oxidation ditch, *Confinement buildings, Total solids, Volatile solids.

Tests at the University of Illinois were conducted using two buildings with oxidation ditches. Detention time, rotor speed, rotor immersion, and loading rates were varied. Oxygen demand, solids, BOD and COD were measured periodically and plotted by a digital computer. Problems with foaming and ammonia odor were encountered, but solved by altering the liquid depth and rotor immersion. Apparently the velocity of the waste in the ditch seems to be the controlling factor in oxidation ditch operation. Adequate velocity and oxygenation occurred when the immersion of the aeration rotor into the waste was equal to approximately one-third of the liquid depth. A liquid volume of 200 to 250 cubic feet of ditch volume per foot of rotor length served to maintain a velocity that prevented solids from settling in the ditch. With sufficient gutter volume to give 50 days detention time, the aerobic digestion process can reduce the 5-day BOD of hog waste from approximately 35,000 mg/l to around 3000 mg/l. (White-Iowa State)

### 0178 - A6, B2, C2, D3, E2

**STUDY OF THE USE OF THE OXIDATION DITCH TO STABILIZE BEEF ANIMAL MANURES IN COLD CLIMATE,**
Minnesota Univ., Minneapolis.
J. A. Moore, R. E. Larson, and E. R. Allred.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 172-177. 3 fig.

Descriptors: *Farm wastes, *Climates, *Air temperature, Biochemical oxygen demand, Chemical oxygen demand, Cattle, Rotors, Stabilization, Waste water treatment.
Identifiers: *Oxidation ditch, *Slatted floor.

When loaded at the rate of one animal per 210 cu. ft. of liquid it appears that the oxidation ditch can be operated in cold weather. From results of this trial it can be projected that the oxidation ditch can successfully function to contain and provide minimal treatment to beef cattle wastes in cold climate with the pollutional threat stored until spring. At that time the liquid which is too polluted to be discharged to a waterway might be applied to a receptive soil media for further treatment. The results of a summer operation at a loading rate of one animal per 140 cu. ft. of liquid, indicate that the system achieved an 87% reduction of 5 day BOD. Additional treatment will be required however, because the BOD of the slurry was 22,000 mg/l at the end of the test period. Results indicate that the oxidation ditch system can be used to treat beef waste in climates which experience extended periods of sub-freezing temperatures, although digestion is minimal at these temperatures. Some foaming resulted but was not a limiting parameter. Normal operation has resulted in a low odor level. Sludge buildup was not a problem with an annual cleanout cycle. (White-Iowa State)

### 0179 - A6, B2, B5, C2, D1, D3

**CHANGES IN COMPOSITION OF CONTINUOUSLY AERATED POULTRY MANURE WITH SPECIAL REFERENCE TO NITROGEN,**
Guelph Univ. (Ontario).
J. B. Edwards, and J. B. Robinson.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 178-184. 5 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Nitrogen, Poultry, Aeration, Nitrification, Denitrification, Oxidation-reduction potential, Rotors, Waste water treatment.
Identifiers: *Nitrogen loss, *Oxidation ditch.

The objectives were (a) to study the nitrogen transformation in continuously aerated liquid manure, (b) to determine the most efficient means of eliminating nitrogen from waste (for situations in which sufficient land is not available to meet guidelines for pollution control) and (c) to determine what steps must be taken to prevent losses of nitrogen from liquid manure (for situations in which crop utilization is an integral part of the operation, and sufficient land is available). The study was limited to liquid poultry manure and this report deals, in a preliminary way, with changes in nitrogen components in such waste continuously aerated in both laboratory units and in an oxidation ditch. The results show that the mechanical rotor as operated was not capable of maintaining strictly aerobic conditions in the ditches for more than a few days. In spite of this, odor did not become a problem. From the limited data obtained, the oxidation ditch appears to be a useful device for controlling the ultimate nitrogen content of the manure before land utilization. By encouraging the nitrification-denitrification sequence nitrogen can be removed and, presumably, by inhibiting nitrification, nitrogen could be conserved. (White-Iowa State)

### 0180 - B2, C2, C3, D1, D3, E1

**FARM WASTE DISPOSAL FIELD STUDIES UTILIZING A MODIFIED PASVEE OXIDATION DITCH, SETTLING TANK, LAGOON SYSTEM,**
Farmland Industries, Inc.
Gerald R. Foree, and Richard A. O'Dell.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 185-192. 7 tab, 6 fig, 8 ref.

Descriptors: *Farm wastes, *Hogs, *Lagoons, *Efficiencies, Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand, Hydrogen-ion concentration, Waste water treatment.
Identifiers: *Oxidation ditch, *Settling tank, Total solids, Fixed solids, Volatile solids.

The system studied was two buildings, capable of holding 10 sows and litters apiece, located over oxidation ditches. The ditches emptied into a settling tank which in turn emptied into a lagoon. Measurements of dissolved oxygen, temperature, pH, BOD, COD, various solids determinations, various nitrogen determinations, and bacterial quantitation were taken and presented in 7 tables and 5 graphs. The data indicated that the oxidation ditch itself operated at approximately 50% efficiency under optimum operating conditions. The total system ditch, settling tank and lagoon appeared to operate between 70 and 90 per cent efficiency, depending on the research parameter studied. (White-Iowa State)

### 0181 - A4, A5, B1, F2

**FEEDLOT POLLUTION CONTROL - A PROFILE FOR ACTION,**
Federal Water Pollution Control Federation, Kansas City, Mo. Missouri Basin Region.
John M. Rademacher, and Anthony V. Resnik.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 193-202. 17 ref.

Descriptors: *Farm wastes, *Water pollution control, *Legislation, Groundwater, Water Quality Act.

Identifiers: *Feedlots, *Animal production, Research, Regulation.

This paper set the stage for the presentation of technical papers which followed at the Cornell University Animal Waste Management Conference. The background of animal production and examples of the pollution problem were given. Factors causing the problem of animal waste disposal were discussed as well as accomplishments to date. These accomplishments included Federal laws to control pollution. A profile for action was presented as a model for action. The essential elements were Re-education, Research and Regulation. He states that we have neither adequate knowledge for control nor full cooperation and involvement of all levels of Government and the private sector to solve the problems resulting from feedlot operations. More attention must be given to feedlot location and research devoted to the institutional problems of animal waste management. There must be an organized and coordinated, interdisciplinary approach to animal waste disposal. (White-Iowa State)

### 0182 - A2, C2, F6

**CATTLE FEEDLOT WATER QUALITY HYDROLOGY,**
Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering.
T. E. Norton, and R. W. Hansen.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 203-216. 2 tab, 14 fig, 14 ref.

Descriptors: *Farm wastes, *Cattle, *Hydrographs, *Water quality, Rainfall simulators, Rainfall intensity, Biochemical oxygen demand, Runoff, Alkalinity, Water pollution control, Waste water treatment.
Identifiers: *Feedlot runoff, *Hydrology characteristics, Surface storage, Effective depth, Overland flow.

The hydrologic and quality characteristics of runoff waste water resulting from precipitation on cattle feedlots are presented. The overall objective of the study was to determine if the hydrology characteristics could be correlated with the quality characteristics through a modification of the flat plate model of overland flow. Once this correlation was established, the results were used to predict the quantity and quality of the runoff from existing feedlots. The field equipment consisted of rainfall simulation equipment and a sample collection and control device. Runoff was collected and analyzed from a 28 sq. ft. plot in 18 separate runs on 13 different feedlots. The pollution characteristics of BOD, dissolved solids and alkalinity were correlated with an effective depth of overland flow. The correlation method and equations developed were used in an example of BOD prediction. (White-Iowa State)

### 0183 - A2, B1, B5, C2

**THE EFFECT OF FEED, DESIGN AND MANAGEMENT ON THE CONTROL OF POLLUTION FROM BEEF CATTLE FEEDLOTS,**
Texas Technological Coll., Lubbock. Dept. of Agricultural Engineering.
W. Grub, R. C. Albin, D. M. Wells, and R. Z. Wheator.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 217-224. 5 fig, 2 tab.

Descriptors: , *Farm wastes, *Cattle, *Runoff, Biochemical oxygen demand, Nitrogen, Phosphorus, Water pollution control.
Identifiers: *Feedlots, *Composition of wastes, Rations, Feedlot layout, Waste accumulation.

Incorporating both engineering and biological aspects, this report contains an analysis of data and suggests management and design practices that could materially reduce the pollution contributed from the small but densely populated feedlot area. The composition and quantity of wastes is looked at. The type of ration and changes in accumulated wastes are discussed in relation to the former topics. The effects of precipitation, surfacing material, land slope, depth of waste accumulation, feedlot layout, and ration composition are discussed with respect to composition and quantity of runoff. (White-Iowa State)

### 0184 - A2, A4, B2, C2, D3

**TREATMENT OF WASTES FROM BEEF CATTLE FEEDLOTS - FIELD RESULTS,**
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 225-241. 8 fig, 4 ref.

Descriptors: *Farm wastes, *Cattle, *Anaerobic conditions, Alkalinity, Biochemical oxygen demand, Chemical oxygen demand, Ammonia, Nitrates, Nitrites, Rainfall, Water pollution, Digestion, Waste water treatment.
Identifiers: *Feedlots, *Aerobic stabilization, *Polishing unit, *Intermittent loading, Volatile acids, Volatile solids, Total solids, Turbine blower.

Results are presented from a field demonstration study to investigate an anaerobic-aerobic treatment system for beef cattle feedlot waste water, some of the management aspects of such a system are discussed, and data are presented on the quality of runoff from beef cattle feedlots. The demonstration system consisted of a 40,000 gallon anaerobic unit which overflowed into a 15,000 gallon aerobic unit. Aerobic stabilization was accomplished by means of a turbine blower and a simple diffuser system. The effluent from the aeration unit flowed to a polishing unit which provided for separation of the residual solids. The ability of this system to reduce the pollution from feedlot runoff was demonstrated. The system was able to absorb shock loads of waste that were periodically scraped into the anaerobic unit. The results of the study showed that frequent addition of wastes to the system, frequent mixing of the anaerobic unit, and removal of only a portion of the contents of the anaerobic unit materially assisted the satisfactory performance of the unit and the maintenance of equilibrium conditions. The individual units have been shown to function adequately with a minimum of attention. Further treatment would be required before the effluent could be released to a receiving stream. (White-Iowa State)

### 0185 - A4, A6, A13, B1, B4, D2, D3

**WASTE DISPOSAL MANAGEMENT,**
Cornell Univ., Ithaca, N.Y.
Charles E. Ostrander.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 242-244.

Descriptors: *Farm wastes, Nitrogen, Mortality, Water pollution effects, Incineration, Storage, Odor, Disposal, Water pollution sources.
Identifiers: Compost, Nuisance, Pollution hazard, Residential areas, Neighbors.

The immediate concern of the author was the improvement and the prevention of further destruction of our environment. He spoke of the magnitude of the agricultural waste problem indicating the greatness of the technological and economic aspects. The importance of animal waste as a source of organic nitrogen was pointed out, as were the dangers of inorganic nitrogen. Methods of handling and storage were brought out. The problem of disposing of mortality cases and possible solutions was discussed. Stress was placed on the creation of a favorable image of agriculture in the eyes of the public. (White-Iowa State)

### 0186 - C2, D2, E3, F1

**MANURE CONSERVATION,**
HUPSI Corp., Wabash, Ind.
Robert M. LaSalle, Jr., and Mark Launder.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 245-248. 1 fig.

Descriptors: *Farm wastes, *Fertilizers, Poultry, Potash, Air-conditioning, Gross profit, Costs, Dehydration, Waste water treatment.
Identifiers: *Phosphoric acid, Anhydrous ammonia, *Manure conservation.

Tests were conducted in the fall and winter of 1967 on a proposed system of manure conservation. Poultry manure was stabilized and used as a fertilizer rather than going through a bio-degradation process. Troughs were placed under the chickens and a weak phosphoric acid solution flowed by gravity under subsequently lower cage levels and finally into a sump from which it was pumped to the upper most levels. Droppings were immediately stabilized, denatured, and deodorized upon falling into the solution. Additional treatment consists of buffering to reduce the acidity to the proper value for fertilizer and adding potash to increase the potash values to that commensurate with the nitrogen and phosphate analysis for commercial use. Buffering can be done with anhydrous ammonia or potash so that either the nitrogen or potash values are augmented. By these means control is available to bring the final product to any desired fertilizer analysis. An analysis of 10-3-2 can command a price of $61.60 per ton with a gross profit of $14.50 if dehydration is used. By refrigerating the solution flowing under the chickens, the chicken house is completely and perfectly air conditioned. (White-Iowa State)

### 0187 - A6, A11, B2, B4, D3

**CAGED LAYER PERFORMANCE IN PENS WITH OXIDATION DITCHES AND LIQUID MANURE STORAGE TANKS,**
Guelph Univ., (Ontario). Dept. of Poultry Science.
J. P. Walker, and J. Pos.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 249-253. 3 fig, 1 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Performance, Anaerobic conditions, Aerobic conditions, Mortality, Odor, Biochemical oxygen demand, Waste water treatment.
Identifiers: *Oxidation ditch, Feed conversion, Aerator, Population equivalent, Egg production.

The hen housed egg production, feed conversion and mortality performance of caged layers in a pen with oxidation ditches was slightly better than that of caged layers in pens with liquid manure, storage tanks. The odor in the pens with oxidation ditches was less offensive than in the pens with anaerobic storage. Aerators, however, should be installed outside the pen area. The tank design is very important from the standpoint of liquid circulation, and clean-out. A drain to a sump hole for cleaning is essential. The foaming problem, while controlled by commercial anti-foaming agents, limits the practical application of aerators for poultry until a more economical means is found. Cage systems that do not need dropping boards (eg. full stair-steps) should be used; this would eliminate shock loading, reduce odors and labor requirements. (White-Iowa State)

### 0188 - A6, A7, A11, B1, B4, F4

**PROBLEMS AND PRACTICES IN SOME SYSTEMS OF MANURE HANDLING IN**

**NORTHERN EUROPE,**
Cornell Univ., Ithaca, N.Y. Dept. of Animal Science.
A. M. Meek, W. G. Merrill, and R. A. Pierce.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 254-259. 4 fig, 6 ref.

Descriptors: *Farm wastes, *Cattle, *Storage, Odor, Disposal, Waste water treatment.
Identifiers: *Dairy cattle, *Handling system, Slatted floors, Poisonous gases, Agitation, Freestall housing.

Dairy manure handling systems and operations were visited in Scotland, England, Denmark and Sweden. The various types of systems consisted of under-building and outside-underground storage facilities with some type of pump or shuttle agitation system. Many incorporated steel or concrete slatted floors with manure storage pits underneath. Problems of odor and poisonous gases were discussed. A list of 15 safety points for the prevention of gas problems was given. Symptoms of gas poisoning were also listed. (White-Iowa State)

### 0189 - A6, F6

**MEASUREMENT OF THE ODOR STRENGTH OF ANIMAL MANURES,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 260-270. 6 fig, 4 tab, 10 ref.

Descriptors: *Farm wastes, *Odor, Poultry, Anaerobic conditions, Pollutant identification, Waste water treatment.
Identifiers: *Vapor dilution, *Threshold Odor Number, *Odor Intensity Index, Liquid dilution, Panel, Batch condition, Odor strength, Ranking.

Strength is a characteristic of an odor that can be measured. In contrast to characteristics such as quality and occurrence which rely only on individual opinion, strength allows associating a number with an odor. This can be very valuable for comparing manure handling systems as to odor production. Measurement of odor strength is usually accomplished by determining the magnitude of dilution required so that the odor is just detectable (olfactory threshold). The human nose is utilized as the detector. The application of the measurement of odor strength to animal manures was attempted in the laboratory. The method of liquid dilution and the method of vapor dilution were investigated. Vapor dilution looks at the odors arising from the manure while liquid dilution is concerned with the odors in the manure or the odor potential of the manure. Fifteen conclusions and observations were made as a result of the study. (White-Iowa State)

### 0190-A6,B2,B3,C2,C3,D3

**MICROBIOLOGICAL AND CHEMICAL CHANGES IN POULTRY MANURE ASSOCIATED WITH DECOMPOSITION AND ODOR GENERATION,**
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
William E. Burnett, and Norman C. Dondero.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 271-291. 18 fig, 1 tab, 53 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, Aerobic bacteria, Anaerobic bacteria, Ammonia, Hydrogen sulfide, Sulfur bacteria, Waste water treatment.
Identifiers: *Olfactory threshold test, *Odor Intensity Index, *Threshold odor numbers, Uric acid, Odor panel, Volatile organic acids.

Changes in the microbial and chemical composition of batch lots of 'dry' and 'liquid' poultry manure during decomposition were related to the production of offensive odors. The decomposition of uric acid by both aerobic and anaerobic uricolytic bacteria appeared to be related to the formation of significant quantities of ammonia. The number of sulfate-reducing bacteria, including Desulfovibrio species, increased during the course of decomposition of liquid poultry manure. These organisms were implicated as producers of some of the hydrogen sulfide in liquid poultry waste. There were apparent correlations between an increase in odor intensity of liquid manure with increased storage time and the concentrations of volatile organic acids, ammonia, and sulfides. (Miner-Iowa State)

### 0191 - A6, A7, A8, C2

**CHEMICAL ASPECTS OF ODOR REMOVAL IN SOIL SYSTEMS,**
Washington Univ., Seattle. Dept. of Civil Engineering.
R. C. Gumerman, and D. A. Carlson.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 292-302. 6 fig, 1 tab, 7 ref.

Descriptors: *Farm wastes, *Odor, *Hydrogen sulfide, Soil moisture, Waste water treatment.
Identifiers: *Soil filter, *Removal mechanism, Detention time, Reaction temperature.

On the basis of the data presented, it was found possible to postulate mechanisms which describe the removal of hydrogen sulfide species on soil in both wet and dry conditions. Removal of high concentrations of hydrogen sulfide from moving air streams is performed much more efficiently by dry soil than wet. Inter-related parameters which influence the removal of hydrogen sulfide by dry sterile soil are detention time, reaction temperature, amount of hydrogen sulfide entering, concentration of hydrogen sulfide, and the total flow rate. A method of design optimization is presented which determines for a given concentration and influent gas temperature, the total flow rate at which the maximum removal of hydrogen sulfide per unit time results. It is felt this design optimization method should be restricted to air streams containing only hydrogen sulfide, until further research delineates the removal mechanism for other odorous gases. (White-Iowa State)

### 0192 - A6, A7, B1, D1

**POULTRY HOUSE DUST, ODOR AND THEIR MECHANICAL REMOVAL.**
Harry J. Eby, and G. B. Willson.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 303-309. 1 tab, 5 fig, 6 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, *Dusts, Filters, Waste treatment.
Identifiers: Foam pad filters, Clogging.

Tests of plastic foam pad filters as a method of trapping the odor carrying dusts from a poultry house exhaust fan air stream have shown that foam pads of 10 to 40 pores per square inch are effective. However, the tests show that such pads become clogged with dust in about 6 to 9 hours of operation. Vacuum cleaning and water washing methods of cleaning for continued use were ineffective and the high initial cost of the foam filter material were deemed to make this method impractical. Tests of a device in which the exhaust air is deflected tangentially across a 1/2 inch mesh screen showed that such methods would remove at least a portion of the odor carrying dust. These were also deemed impractical in that the filter ability would appear to be a direct function of the relative humidity and as such would be the least efficient when low relative humidity within the poultry house would make the dust problem the greatest. Other methods of possible filtering techniques were discussed. (White-Iowa State)

### 0193-A2,C1,C2,D1,D3,F6

**CHARACTERISTICS OF AQUEOUS SOLUTIONS OF CATTLE MANURE,**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
John C. Ward, and E. M. Jex.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 310-326. 5 fig, 4 tab, 25 ref.

Descriptors: *Farm wastes, *Cattle, *Aqueous solutions, Biochemical oxygen demand, Dissolved solids, Hydrogen ion concentration, Foaming, Oxidation-reduction potential, Coagulation, Waste water treatment.
Identifiers: *Volatile solids, *Colloidal properties, Activation energy.

The primary objective was to investigate the aqueous characteristics (biochemical oxygen demand, conductivity, pH, oxidation-reduction potential, coagulation and colloidal properties, dissolved solids, volatile solids, and foaming) of solutions of cattle manure containing the combined urine and feces present in samples from cattle feedlots. This information could then be used in the design of facilities for treating runoff from cattle feedlots. It was assumed that treatment of this runoff would probably be by means of lagoons used to capture the runoff, and that these lagoons would be artificially aerated. In this type of aerobic treatment, the biochemical oxygen demand is satisfied in much the same way as in a stream. Formulas were developed and explained and 25 references were utilized. (White-Iowa State)

### 0194 - C2, F6

**TYPICAL VARIATIONS ENCOUNTERED IN THE MEASUREMENT OF OXYGEN DEMAND OF ANIMAL WASTES,**
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. Paul Taiganides, and Richard K. White.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 327-335. 2 tab, 7 fig, 9 ref.

Descriptors: *Farm wastes, *Biochemical oxygen demand, *Oxygen demand, Temperature, Hogs, Cattle, Poultry, Sheep, Pollutant identification, Waste water treatment.
Identifiers: *Warburg, *Sewage Seeding, *BOD oxygen probe, Dilution effects.

Tables and figures were presented to emphasize the inherent variability in the parameters used in measuring oxygen demand. Reliable values of oxygen demand are essential because they are used as design parameters in waste treatment plants. Past and present experiments are being done with large numbers of replicates for each experiment to determine a reliable range of values for the various oxygen demand parameters of animal wastes. BOD was expressed in milligrams of oxygen required per gram of total solid matter (mg $O_2$/g TS) since values reported in ppm or mg/l are useless because of the large variability in solid content of the waste and the high dilutions needed for the BOD test. Three methods of determining the BOD of animal waste were tested. These were the standard test, the BOD oxygen probe and Warburg. Effects of temperature and seeding with sewage were also explored. (White-Iowa State)

### 0195 - A9, B5, C3

**ROLE OF EXCRETED ANTIBIOTIC IN MODIFYING MICROBIAL DECOMPOSITION OF FEEDLOT WASTE**

Colorado State Univ., Fort Collins. Dept. of Microbiology.
S. M. Morrison, D. W. Grant, Sister M. P. Nevins, and Keith Elmund.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 336-339. 1 tab, 2 ref.

Descriptors: *Farm wastes, *Antibiotics, Cultures, Cattle, Confinement pens, Biodegradation, Pesticide residues, Assay, Water pollution sources.
Identifiers: *Chlortetracycline, *Biological stabilization, Feedlot, Manure decomposition, Microbial decomposition, In situ manure.

The results presented in this paper are derived from studies on the process of biological stabilization of feedlot manure and the acceleration of the stabilization process. It is a specific study on some microbial inhibitions which may be playing a role in the biodegradation of feedlot waste. Samples of manure were taken from pasture, in situ manure from feedlot pens, and stockpiled manure from a feedlot. Cultures of the filter-sterilized manure extract gave rather conclusive evidence that the substance causing growth inhibition in the extracts was chlortetracycline residue in the excreted manure. It was calculated that 75% of the ingested antibiotic was excreted in the feces. Temperature tests indicate that during the winter months biodegradation of manure is not only inhibited by cold temperatures but also by the persistence of the antibiotic residue and the continuous deposition of antibiotic containing fresh manure. (White-Iowa State)

### 0196 - E1, B5, C2

**THE INFLUENCE OF VARIOUS FACTORS ON POULTRY LITTER COMPOSITION,**
Pennsylvania State Univ., University Park. Dept. of Animal Science.
F. F. El-Sabban, T. A. Long, R. F. Gentry, and D. E. H. Frear.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 340-346. 4 tab, 18 ref.

Descriptors: *Farm wastes, *Poultry, Nitrogen, Carbohydrates, Insulation, Ventilation, Mineralogy, Moisture, Correlation analysis, Nutrients, Waste water treatment.
Identifiers: *Litter composition, *Nutritive value, Dry matter, Crude protein, True protein, Ether extract, Crude fiber.

A study was conducted to determine the chemical composition of poultry waste (litter and manure), relevant to its possible utilization as a source of nutrients. Litter samples were obtained from 33 broiler houses and 22 laying houses. Fresh manure was secured from 5 houses having layers in cages. The dry matter content was determined and samples were analyzed for crude protein, true protein, crude fiber, ether extract, and total ash. In addition, twelve mineral elements were determined. Poultry litter was found to contain considerable amounts of nutrients, particularly nitrogen and carbohydrates. Various factors such as bird type, bird density, kind of litter base material, litter depth, and poultry house conditions (ventilation, insulation, and house temperature) were all found to affect the proximate components of poultry litter. If poultry waste is to be utilized for its nutritive value for plants or animals, it is recommended that each batch be chemically analyzed before use. Although a limited number of samples was available, variation in composition was sufficient to warrant their individual analysis. (White-Iowa State)

### 0197 - A6, B5, C1

**REMOVAL OF WATER FROM ANIMAL MANURES,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.

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Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 347-362, 1969. 8 fig, 2 tab, 12 ref.

Descriptors: *Farm wastes, *Poultry, *Moisture content, Odor, Weight. Volume. Humidity, Waste water treatment.
Identifiers: *Equilibrium moisture content, *Relative humidity, Handling characteristics, Volatile solids, Drying times, Thermal removal.

The removal of water from animal manures changes the handling characteristics of the manure, reduces the weight and volume to be handled, and reduces the offensive odor of the manure. Water can be removed from manure by mechanical, thermal, and absorptive means. Mechanical methods such as direct pressing present the difficulty of the removed water containing considerable volatile solids. Thermal removal was investigated from the standpoint of utilizing a thin layer, unheated air, and very low or 'static' air velocity. The equilibrium moisture content of chicken manure is comparable with other agricultural hygroscopic materials. Equilibrium moisture content values are presented for temperatures 70, 90, 110F. Drying times for chicken manure under these conditions is in terms of days. Drying times are greatly influenced by sample variation. Effects of humidity on drying time are significant but sample variation has an effect similar to a plus or minus 15% relative humidity change. Moisture loss from a 'deep' layer of manure is less than that from a free water surface. (White-Iowa State)

### 0198 - A4, A5, A6, A7, F1, F2

**LIVESTOCK PRODUCTION VS. ENVIRONMENTAL QUALITY - AN IMPASSE,**
Economic Research Service, Washington, D.C. Natural Resource Economics Div.
Joseph P. Biniek.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 363-368, 1969. 14 ref.

Descriptors: *Farm wastes, *Economic efficiency, Water Quality Act, Air pollution, Odors, Water pollution control.
Identifiers: *Livestock production, *Production efficiency, *Environmental quality, Quality standards, Public conern, Economic development.

The possibilities of merging the two objectives of production efficiency and environmental quality are explored. To establish a basis for merging the two objectives, the author discusses environmental quality, quality standards, and public concern. Secondly he reviews the changing concepts of economic efficiency and illustrates these changes by discussing four stages of economic development. The discussion is concluded with a section devoted to the merging of the two objectives, environmental quality and production efficiency. An impasses can be averted, but it will require new modes of thought, and constructive responses to new situations. (White-Iowa State)

### 0199 - A6, B2, B3, C2, D2, D3, F1

**RELATIVE ECONOMICS OF ANIMAL WASTE DISPOSAL BY SELECTED WET AND DRY TECHNIQUES,**
Resource Engineering Associates, Inc., Stamford, Conn.
Robert W. Okey, Robert N. Rickles, and Robert B. Taylor.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 369-387, 1969. 5 fig, 17 tab, 11 ref.

Descriptors: *Farm wastes, *Cattle, *Cost analysis, Effluent, Biochemical oxygen demand, Chemical oxygen demand, Odor. Aeration, Nitrogen, Denitrification, Ultimate disposal, Incinération, Waste water treatment.
Identifiers: Wet systems, Dry systems, Effluent standards, Clarifier systems, Biological conversion, Solids conditioning system, Scrubbing system, Ancillary system.

The report presents the basic elements required for the design of two waste treatment facilities to handle the wastes from feedlots carrying 500, 1000, 5,000, 10,000, and 25,000 animals. The plants were designed to meet specified liquid and gaseous effluent standards. The standards selected are believed to be consistent with present and projected effluent requirements. It should be noted that some water courses may not be able to assimilate effluents of the quality discussed here. The two systems designed and costed in this work employed on one hand more or less conventional liquid waste treatment procedures; the other employed incineration and treated the undiluted animal waste as delivered as a solid waste, i.e., sludge. The capital and operational cost of these systems were computed and related to the number of animals and the gain anticipated in the feedlot. A waste treatment cost in terms of animal-years and per pound was then obtained. Five conclusions were reached as a result of the study, among them, that wet systems are more expensive to own and operate than systems designed to handle solids. (White-Iowa State)

### 0200-C2, E2, F1

**THE ECONOMICS OF POULTRY MANURE DISPOSAL,**
New York State Coll. of Agriculture, Ithaca.
R. E. Linton.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 388-392, 1969.

Descriptors: *Farm wastes, *Poultry, *Economics, *Land use, Fertilizers, Nitrogen, Phosphorus, Potash, New York, Disposal, Waste water treatment.
Identifiers: *Land disposal, *Cost calculations, *Waste management, Transportation costs, Catskill resort industry.

This study was initiated in response to the general problem of conflicts over rural land use, particularly those involving farm operations. More specifically and as a notable example, the study dealt with the problems of conflict between poultry and other land uses. The problem of land use conflict related to waste management was approached through the aspect of recognizing the internal costs to farmers of some of the alternatives in waste management. As a result of the study one particular pattern of manure disposal seemed to justify serious consideration and was singled out for discussion and cost calculations. This pattern included some means of land spreading as a practical and acceptable disposal method. Comments were made about the value of poultry manure in replacing commercial fertilizer, and this value is discussed as a means of at least partial disposal cost recovery. (White-Iowa State)

### 0201-B1, D1, D2, D3

**ECONOMIC RETURN FROM VARIOUS LAND DISPOSAL SYSTEMS FOR DAIRY CATTLE MANURE,**
Cornell Univ., Ithaca, N.Y.
L. W. McEachron, P. J. Zwerman, C. D. Kearl, and R. B. Musgrave.
Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 393-400, 1969. 11 tab, 13 ref.

Descriptors: *Farm wastes, *Fertilizers, *Rotations, Cattle, Economics, Soil types, Disposal, Waste water treatment.
Identifiers: *Dairy cattle, Land disposal, Continuous corn, Lima silt loam, Manure hauling and spreading, Total digestible nutrients.

Census of Agriculture data are presented to indicate that dairy cattle manure could well be disposed of on the land. Farm cost accounting data are presented to indicate that cost per ton of hauling and spreading averaged $1.92 for farms with free stalls and about 140 cows to $3.18 for those with stanchions and 65 cows. Percent yield increase on crops grown per ton of manure applied range from .4% for oats to 6.6% for alfalfa. These percent yield increases were generalized without regard to mineral fertilization and applied to Warren's (1968) yield data for the state of New York at various farming levels. Without a charge for hauling and spreading dairy cattle manure crop yield returns ranged from $1.42 per tone to a deficit of $0.26. (White-Iowa State)

### 0202-A6, B2, B4, E2, F1

**ECONOMIC EVALUATION OF LIQUID MANURE SYSTEMS FOR FREE STALL DAIRY BARNS,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Economics.
George L. Casler.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 401-406, 1969. 3 tab.

Descriptors: *Farm wastes, *Economics, *Value, Cattle, Costs, Odor, Fertilizer, New York, Waste water treatment.
Identifiers: *Liquid manure system, *Labor distribution, *Labor requirements, Dairy cattle, Free stall barns.

The purpose was to evaluate liquid manure systems in free-stall dairy barns primarily from an economic viewpoint. If a liquid manure system is to be justified, such justification will have to be based on other advantages in addition to increased manure value and reduced labor requirement. The primary other advantage is the possibility of not hauling manure at periods of peak labor demand for planting and harvesting crops. However, to actually reap the benefits of improved labor distribution, a dairyman needs a reasonably long storage period and must very carefully plan his cleaning schedule. In addition, the very unpleasant odor created at the time the storage tank is emptied precludes the use of a liquid manure system in areas where neighbors would object to this odor. It appears to the author that the air pollution or odor problem is much more serious with a liquid manure system than with daily spreading. (White-Iowa State)

### 0203-A6, B1, F2

**WHO SHOULD REGULATE POULTRY CONFLICT PROBLEMS,**
Cornell University, Ithaca, N.Y. Coll. of Agriculture.
David J. Allee, and Pierre Clavel.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 407-414, 1969. 5 ref.

Descriptors: *Farm wastes, *Poultry, *Technology, Local governments, State government, Odor, Communication, Waste water treatment.
Identifiers: *Regulatory mechanisms, Industry committee, Political resources, Waste management technology, Conflict, Resolution of problems.

Economic and social theory applicable to conflict situations, such as those that arise downstream or downwind from poultry houses, has some ability to indicate directions for administered solutions to these problems. Based upon such theory, related research and a case study of a number of ways in which rural communities have dealt with situations of stress between components of the community, the outlook for regulatory devices is appraised. An informal voluntary industry committee approach is found to be as effective in bringing together necessary technical expertise and social regulatory mechanisms as any other approach which the limited resources of many rural communities can support. It is suggested that because of a shortage of administrative and political resources many rural areas will resist effective resolution of conflict problems due to agricultural wastes until finally controls will be imposed by essentially urban oriented units of government. (White-Iowa State)

### 0204-A4, A5, A6, A7, A8, A10, A11, C1, C2, D1, D2, D3, E2, E3

**POULTRY POLLUTION: PROBLEMS AND SOLUTIONS.**
Michigan Agricultural Experiment Station, East Lansing.

Research Report 117, Farm Science, July 1970. 55 pages.

Descriptors: *Farm wastes, *Poultry, *Dehydration, Eggs, Nitrogen, Diets, Feeds, Odor, Water pollution, Air pollution, Soil contamination, Disease, Insects, Standards, Land use, Septic tanks, Sludge disposal, Digestion, Ventilation, Rates of application, Corn, Nitrate, Chemical properties, Drying, Moisture content, Nutrients, Taste.
Identifiers: Environmental quality, Indoor lagoons, Laying hens, Feed conversion, Egg production, Dehydrated poultry waste, Feed efficiency.

The report contains eleven articles with an introduction and a table compilation of properties of poultry waste that were analyzed. Reports on indoor septic handling of poultry manure and effect of application rate of chicken manure on corn yields are presented. A large part of the report deals with drying and feeding poultry manure to laying hens. Results of feeding dehydrated poultry waste to laying hens and its effect on egg production, feed conversion, body weight, egg weight, shell thickness, Haugh score, egg taste, and quality changes during storage are presented. Acceptability and digestibility of poultry and dairy wastes by sheep is also reported. Bacteriological procedures and current research being carried out at Michigan State University conclude the report.
(White-Iowa State)

### 0205-A4, A5, A6, A8, A10, A11, A12, B1

**INTRODUCTION,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
H. C. Zindel, and C. J. Flegal.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 4-7.

Descriptors: *Farm wastes, *Poultry, Odor, Water pollution, Air pollution, Soil contamination, Technology, Nitrates, Nitrites, Disease, Insects, Treatment, Disposal, Standards, Land use.
Identifiers: *Environmental quality, *Confinement production, Animal management, Facility design.

The introductory remarks explain that agriculture-related pollution is but one part of a large national problem; so it must be considered together with municipal, industrial, marine and all other types of pollution in developing an integrated plan for improving the quality of our environment. The volume of livestock wastes produced is a function of the degree concentration and the size of individual production units. Animal wastes are of concern in water, air, and soil pollution. Examples of the increasing numbers of livestock and poultry being produced are given. New and improved technology is needed to handle the wastes from these animals. Problems discussed concerning pollution are: disease, odor, soil contamination, and insects. Four areas of emphasis are given that encompass the elements of a program for controlling animal wastes. (See also W71-03555) (White-Iowa State)

### 0206-A6, B2, D1, E1

**POULTRY MANURE HANDLING BY INDOOR SEPTIC TANKS (SO-CALLED 'INDOOR LAGOONS'),**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
J. A. Davidson, and C. J. Mackson.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 8-9.

Descriptors: *Farm wastes, *Poultry, *Septic tanks, *Sludge, Sludge disposal, Digestion, Odor, Ventilation.
Identifiers: *Indoor lagoons, Laying hens, Compressed air agitation, Paddle wheel agitation, Floor space.

The report details the use of shallow water filled tanks for the disposal of poultry manure. The experiment was carried on for 5 years, during which time several variations were used. The original experiment consisted of a tank 10' x 24' x 2' deep in a pen 20' x 24'. The tank was filled with 18" of water and all droppings were caught in the tank. The second year, compressed air was used to agitate the material. Approximately 9 inches of sludge was cleaned out after 11 months of operation. Flies were no problem. Successive experiments used different amounts and methods of agitation. Each year the sludge accumulation was cleaned out with a septic tank service truck. Indoor septic tanks (indoor lagoons) covering 1/2 the floor space can handle the droppings from 300 laying hens for at least 11 months. This means one annual cleaning. This method could be used in cage operations.
(White-Iowa State)

### 0207-A8, C2, E2

**THE EFFECT OF APPLICATION RATE OF CHICKEN MANURE ON THE YIELD OF CORN,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
L. S. Robertson, and John Wolford.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 10-15. 4 tab.

Descriptors: *Farm wastes, *Poultry, *Chemical properties, *Rates of application, Hydrogen ion concentration, Phosphorus, Potassium, Soil tests, Corn, Crop production, Michigan, Nitrate, Magnesium, Carbon.
Identifiers: *Plant food content, Huron County Michigan.

The report begins by giving an indication of the magnitude of the poultry manure problem in Michigan. Tables showing the chemical characteristics and plant food content of chicken manure are presented. The effect of high rates of manure application upon soil test results are shown. The application of 46.4 tons/acre of manure significantly increased the levels of phosphorus, potassium, magnesium, nitrate, and percent of carbon in the soil. At the same time, the pH level was reduced from 7.7 to 7.1. An experiment involving different rates of poultry manure application, one fertilizer application, and no treatment was used to determine the effect of chicken manure on corn grain yield. The use of commercial fertilizer did not increase corn yields. Previous field management made this result expected. The use of several rates of manure has not greatly affected the yields. The use of 46.4 tons/acre tended to decrease corn yields slightly. It is not known at the present time whether this apparent depression is real. The data suggest that a tremendous quantity of chicken manure can be incorporated into the soil without any opportunity for damage to a corn crop.
(White-Iowa State)

### 0208-A6, B3, C1, C2, D1, D2, F1

**MANURES,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.

Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
T. C. Surbrook, J. S. Boyd, and H. C. Zindel.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, East Lansing. July 1970, p 16-20. 5 tab, 1 fig.

Descriptors: *Farm wastes, *Poultry, *Cattle, *Hogs, *Drying, Moisture content, Nutrients, Bulk density, Costs, Screens, Electric power.
Identifiers: *Dryer operation, Hammermill, Drying chamber, Fuel consumption.

The report gives details and test results from a machine used for drying animal waste. Production figures for the drier while processing different kinds of animal excreta are given. Details of the drier operation are described. Initial moisture contents ranged from 72 to 82 percent. The machine incorporates inclined shaking surfaces and screens, a hammermill and temperatures from 200 to 1100F. The drier successfully processed dairy, beef, swine and poultry excreta. Costs to produce one ton of the dried product are given. A table gives projected numbers of animals which the machine might serve. Density and nutrient levels of the dried excreta are listed. Odors were less intense than that of fresh excreta. (White-Iowa State)

## 0209-A11, C2, E3

### THE UTILIZATION OF POULTRY WASTE AS A FEEDSTUFF FOR GROWING CHICKS,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, and H. C. Zindel.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 21-28. 5 tab, 21 ref.

Descriptors: *Farm wastes, *Poultry, *Dehydration, Amino acids, Analysis, Chemical properties, Diets, Nutrients, Bacteria, Feeds, Efficiencies, Weight, Mortality.
Identifiers: *Feed composition, Dehydrated poultry waste, Significance, Feed efficiency.

Two experiments were conducted to determine the nutritional value of dehydrated poultry waste (DPW) for growing chicks from 1 to 28 days of age. The four-week mean body weight of Leghorn-type chicks was not influenced when up to 20 percent of the diet consisted of the DPW. Diets which contained levels of 10 and 20 percent DPW, when fed to broiler-type chicks, resulted in a reduction in four-week mean body weight; 5 percent DPW had no influence on the four-week mean body weight. Food efficiency was inversely related to the level of DPW in the diet; i.e., the higher the level of DPW, the poorer the feed efficiency. However, in the trial in which broiler-type chicks were used, added fat placed in the diet which contained 20 percent DPW improved weight gain and feed efficiency. It is suggested that the DPW used in these trials was a low energy product. (White-Iowa State)

## 0210-A11, C2, E3

### THE RESULT OF FEEDING DRIED POULTRY WASTE TO LAYING HENS ON EGG PRODUCTION AND FEED CONVERSION,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, and H. C. Zindel.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 29-30. 2 tab.

Descriptors: *Farm wastes, *Poultry, Eggs, Feeds, Diets, Corn, Lipids, Calcium, Phosphorus.
Identifiers: *Egg production, *Feed conversion, Dried poultry waste, White Leghorn layers.

Four replicates of eight birds each were fed one of thirteen possible diets which were presented in tabular form. The 416 White Leghorn type layers were on test for 139 consecutive days. Each hen was confined in an individual cage having a floor area of 8 x 16 inches. The percent egg production on a hen housed basis and kilos of feed per dozen eggs produced are also presented in tabular form. These data are presently being statistically analyzed to determine the differences, if any, between the various treatments. It appears that hens receiving control rations containing 10, 20, and 30 percent dried poultry waste have respectively lower production and higher feed requirements per dozen eggs. (White-Iowa State)

## 0211-A11, C2, E3

### THE EFFECT OF FEEDING DEHYDRATED POULTRY WASTE ON PRODUCTION, FEED EFFICIENCY, BODY WEIGHT, EGG WEIGHT, SHELL THICKNESS AND HAUGH SCORE,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, and H. C. Zindel.
In: Research Report 117, Farm Science, MSU Agricultural Experimental Station, July 1970, p 31-33. 3 tab.

Descriptors: *Farm wastes, *Poultry, *Dehydration, *Diets, Feeds, Eggs, Lipids, Efficiencies, Performance, Weight, Protein, Nitrogen.
Identifiers: *Production, *Feed efficiency, Body weight, Egg weight, Shell thickness, Haugh score, Significant difference.

In this egg production experiment, one replicate of 18 twenty-six-week-old Leghorn type pullets was placed on each of five different rations. The rations varied from 0% to 40% dehydrated poultry waste (DPW) plus fat. The production trial was conducted for 366 days with the birds in individual cages on a 15-hour-per-day light schedule. Protein-nitrogen supplied in each of the rations was calculated to be equal. The highest percent egg production resulted in those birds which received 10% DPW in the ration. Although production varied from 61.62% to 53.16% production, there was no significant difference in hen housed production. Feed efficiency again was inversely proportional to the amount of DPW in a ration, with the best efficiency having 0% DPW in the ration. However, an addition of animal fat to the ration resulted in a slight improvement in feed efficiency. It is also interesting to note that those birds which received more than 10% DPW in their diet did not increase in body weight comparable to the control ration. The egg weight became smaller as the percent of DPW was increased in the diet. These differences were not significantly different. Although there were slight differences in shell thickness, again there were no significant differences due to the diet in any of these rations. All of the experimental rations had a significantly higher Haugh score than the control diet. The Haugh scores ranged from 67.7 to 76.8. (White-Iowa State)

## 0212-A11, A12, A13, E3

### THE EFFECT OF FEEDING DEHYDRATED POULTRY WASTE TO LAYING HENS ON THE TASTE OF THE RESULTING EGGS,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, H. C. Goan, and H. C. Zindel.
In: Research Report 117, Farm Service, MSU Agricultural Experiment Station, July 1970, p 34-38. 2 tab, 9 ref.

Descriptors: *Farm wastes, *Poultry, *Dehydration, Diets, Eggs, Evaluation, Taste, Control.
Identifiers: *Dehydrated poultry waste, Taste test, Consumer Preference Panel.

Poultry feces, from caged layers, were collected and dried. The resulting product was designated as dehydrated poultry waste (DPW). DPW was fed at dietary levels of 10, 20 and 30 percent to Single Comb White Leghorns in individual wire cages. A cage-type laying diet was used as a control. The diets were fed for four months before any eggs were collected for taste panel evaluation. Eggs from each treatment group were hard-cooked and prepared for a Consumer Preference Panel. The eggs were evaluated on the basis of taste difference and then ranked for preferred taste. The dietary levels of DPW fed had no significant (pA.05) effect on the taste of eggs. Panel members were unable to detect any consistent taste difference for the DPW and control eggs. Two thirds of the time, panel members liked the taste of the DPW eggs over the taste of the control eggs. In each ranking test, panel members preferred the control eggs over the DPW eggs. (White-Iowa State)

## 0213-A11, C1, C2, E3

### ACCEPTABILITY AND DIGESTIBILITY OF POULTRY AND DAIRY-WASTES BY SHEEP,

Michigan State Univ., East Lansing.
J. W. Thomas.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 42-44. 2 tab.

Descriptors: *Farm wastes, *Poultry, *Sheep, *Cattle, Protein, Nitrogen, Animal metabolism, Digestion, Cellulose, Lignins, Fiber, Diets.
Identifiers: Total digestible nutrients, Dry matter, Digestibility, Soybean meal, Nutritive value.

Dried poultry and dairy wastes as about one third the total mixed ration were readily accepted by sheep. The complete ration was about 60% digestible with a TDN value of about 56. The digestibility of the poultry feces was more than that of the dairy feces. Protein of these wastes was less digestible than that of soybean meal but had a biological value equal to that of soybean meal for growing sheep. (White-Iowa State)

## 0214-A4,A5,A8,C2,D3,E2

### RELATIONSHIP OF AGRICULTURE TO SOIL AND WATER POLLUTION.

Cornell Univ., Ithaca, N.Y.

Proceedings, Cornell University Conference on Agricultural Waste Management, January 19-21, 1970. Ithaca, 1970. 270 p.

Descriptors: *Soils, *Farm wastes, *Fertilizers, Groundwater, Precipitation, Potassium, Poultry, Cattle, Hogs, Nitrogen, Nitrate, Phosphorus, Phosphates, Rates of application, Nutrients, Effluent, Aquifer, Ammonia, Soil contamination, Water pollution, Water table, Oxidation lagoon, Irrigation, Aeration, Biochemical oxygen demand, Chemical oxygen demand, Odor, Biological treatment, Costs, Denitrification, Nitrification, Sludge, Storage, Nutrient requirements, Florida, Nebraska, Surface runoff, Infiltration.
Identifiers: *Feedlots, Oxidation ditch, Slotted floors, Aerator, Spreading, Land disposal.

The 1970 Conference attempted to bring knowledgeable individuals from many disciplines together to discuss various aspects of the problem. It was designed to serve as a mechanism for transmitting new research findings to those interested in this area and to demonstrate that agriculture is aware of its potential contributions to environmental pollution as well as its responsibility to society to find methods of alleviating such pollution while increasing the efficiency of production. The Conference played a useful role in providing communication across disciplines. Thirty-two papers are published in the proceedings dealing with all areas of agricultural pollution. (White-Iowa State)

## 0215-A8, E2

### MOVEMENTS OF NUTRIENTS FROM POULTRY MANURE IN SOIL,

Rutgers University.
J. E. Steckel.
Relationship of Agriculture to Soil and Water

Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, 1970, p. 30.

Descriptors: *Farm wastes, *poultry, soils, soil water, lysimeters, depth, precipitation, potassium, calcium, magnesium, sodium, nitrate, chlorine, sulfates, phosphates, rates of application.
Identifiers: *Plow-furrow-cover

Poultry manure was Plow-Furrow-Cover (PFC) applied at depths of 6 to 7 inches into Freehold sandy loam (20% clay in the B horizon) on June 6 1968. The application rates were 0, 15, 30 and 40 tons of water-free equivalent per acre. Soil water samples were taken with suction lysimeters of depths of 12, 18, 24, 36, and 48 inches. Chemical analysis of the water has included determinations of the contents of K, Ca, Mg, Na, $NH_4$-N, $NO_3$-N, $NO_2$-N, Cl, $SO_4$ and $PO_4$. Analytical data was presented from samplings of October 4, 1969 (391 days and 50 inches of rain after PFC). The October 14 sampling indicated increased element concentrations were again increased, even at the 48-inch depth. Data were presented on the amount of elements dissolved in the soil water for each of the 5 depths studied, and for the total in the 9 to 48-inch soil depth. (White-Iowa State)

## 0216-A5, A8

**GROUNDWATER QUALITY AND FLUCTUATIONS IN A SHALLOW UNCONFINED AQUIFER UNDER A LEVEL FEEDLOT,**
Department of Agriculture, Lincoln, Nebr.
L. N. Mielke, J. R. Ellis, N. P. Swanson, J. C. Lorimor, and T. M. McCalla.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 31-40. 2 tab, 4 fig, 13 ref.

Descriptors: *Farm wastes, *Cattle, *Groundwater, *Nitrate, Aquifer, Discharge, Aquifer characteristics, Effluent stream, Groundwater recharge, Transmissivity, Water level fluctuations, Ammonia, Nebraska, Soil contamination, Observation wells, Water table, Infiltration.
Identifiers: *Feedlot, Platte River Valley.

The quality was investigated of the groundwater in the proximity of a level feedlot on a permeable soil with fluctuating high water table. At the feedlot site, the aquifer consists of 30-35 feet of high quality gravel having a coefficient of transmissibility in the range of 90,000-120,000 gallons per day per foot. Aquifer recharge occurs as a result of direct precipitation and interflow from the valley uplands. Six observation wells were installed in the vicinity of the feedlot as well as six water level measuring wells. Two recording wells, constructed of 4-inch diameter aluminum irrigation pipe, were jetted into the gravel aquifer. The water table depth at the feedlot varies with the season. Groundwater level changes reflect major rainstorms within hours after the event. The maximum groundwater elevation under the feedlot was approximately 2 feet below the soil surface. Soil cores were taken to determine the quantity of nitrate which could move into the water table. Low levels of nitrate were found below the first foot. Ammonia was present in only moderate amounts below 3 feet (A30ppm) and rapidly decreased in concentration with increased depth to the water table. Analysis of the core samples indicated that downward movement of nitrates and other forms of nitrogen in the soil was minor. The 12-15 inches of manure pack decreased the actual penetration depth of the nitrogen into the profile. Some samples exhibited levels of nitrate that exceeded Public Health standards (10ppm). This may have been due to the application of anhydrous ammonia prior to the first irrigation. Generally, the nitrate analysis showed relatively low nitrate level in the profile.
(White-Iowa State)

## 0217-A4, A5, A8, E2

**POLLUTION FACTORS ASSOCIATED WITH EXCESSIVE POULTRY LITTER (MANURE) APPLICATION IN ARKANSAS,**
Arkansas Univ., Fayetteville. Dept. of Agronomy.
Leslie H. Hileman.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 41-47. 9 tab, 1 fig, 5 ref.

Descriptors: *Farm wastes, *Poultry, Water pollution, Soil contamination, Rates of application, Soil tests, Phosphorus, Potassium magnesium, Salts, Ions, Nitrates.
Identifiers: *Poultry litter, Mono-valent ions, Divalent ions.

There is an estimated one million tons of poultry manure or manure plus litter produced from 390.. million chickens and turkeys grown in Arkansas annually. The waste manure-litter is being returned to the soil often at rates exceeding 10 tons per acre annually. The data presented indicates that soil pollution and related problems may occur. These problems can be considered as: (1) excess soluble salt, (2) chemical imbalance with particular reference to K and the mono-valent to di-valent ratio, (3) excessive nitrate production and accumulation to toxic levels in forage and farm water supplies, and (4) forages deficient in magnesium for adequate animal nutrition. Further studies are needed to understand the mechanisms by which these conditions are carried out in the soil medium so that effective measures can be taken to prevent soil and water pollution. (White-Iowa State)

## 0218-A4, A6, B2, D3, E2

**REDUCING THE POLLUTION POTENTIAL OF LIVESTOCK WASTES WITH IN-THE-BUILDING OXIDATION DITCHES,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
D. L. Day.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970. Ithaca, 1970, p 77-84. 11 fig, 3 ref.

Descriptors: *Farm wastes, Oxidation lagoon, Irrigation, Aeration, Biochemical oxygen demand, Odor, Aerobic treatment, Labor, Rotors, Denitrification, Coagulation, Effluent.
Identifiers: *Oxidation ditch, *Slotted floors, Aerator, Clarifier.

A low-odor, low-labor, system of managing livestock wastes from animal to field is discussed. The system consists of (1) a confinement building for livestock, with self-cleaning, slotted floors; (2) an oxidation ditch beneath the slotted floors; (3) a nonoverflow of mixed liquor from the oxidation ditch; and (4) irrigating equipment for removing surplus liquids and solids from the lagoon and distributing them on nearby land when convenient for the operator. This system greatly improves the quality of the waste water, but without further treatment the waste water would probably not meet quality criteria for the receiving water. Thus the main advantages of the system are: low labor, low odor, low stream-pollution potential, and operator convenience. (White-Iowa State)

## 0219-B1, D1, D2, D3, F1

**THE CONCEPTUAL DESIGN OF AN ECONOMICALLY FEASIBLE ANIMAL WASTE DISPOSAL SCHEME,**
Resource Engineering Associates, Wilton, Conn.
R. W. Okey, and R. N. Rickles.
In: Relationship of Agriculture To Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 85-97. 11 tab, 4 fig, 11 ref.

Descriptors: *Farm wastes, *Cattle, *Biological treatment, Treatment facilities, Capital costs, Operating costs, Installation costs, Sludge, Centrifugation, Denitrification, Phosphorus, Nitrogen, Incineration, Biochemical oxygen demand, Chemical oxygen demand
Identifiers: *Feedlot, Population equivalent, Waste management, Clarifer, Transport system.

Based on earlier work, a complete system for the capture, transport and treatment of the wastes from a 25,000 animal lot was presented. System capital costs are seen to be about $1.00 - $2.00/ton, and operating costs are around $3.00 - $4.00 per ton of wet waste. These costs result in a cost/lb gained of less than half a cent to about a cent. The costs for the least expensive system are an order of magnitude below feed costs. The installation costs are in the order of $15.00 to $40.00/animal or less than the capital cost as the least expensive confinement scheme. Economic feasibility is a combination of many things. One of the most important is the relevance of a particular item when all the costs are considered. The costs of waste treatment at feedlots would appear to represent roughly the same fraction of the total costs as seen in other industries. (White-Iowa State)

## 0220-A8, B2, B4, E2, F1

**THE ECONOMICS OF STORING, HANDLING AND SPREADING OF LIQUID HOG MANURE FOR CONFINED FEEDER HOG ENTERPRISES,**
M. F. McKenna, and J. H. Clark.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 98-110. 12 tab.

Descriptors: *Farm wastes, *Hogs, *Storage capacity, Chemical analysis, Fertilizers, Storage tanks, Value, Soil contamination, Nitrogen, Phosphorus, Potassium, Nutrient requirements, Linear programming.
Identifiers: *Spreading, Seasonal application, Disposal costs.

The main hypothesis made at the outset of the study, that the economically optimal storage capacity would be affected by the density of hogs per acre and the crops under cultivation on the farm was supported. Of these two factors it was found that the ratio of hogs per acre was the more significant. For a spreading operation with the relatively high fixed costs associated with spreading, farms with smaller herd sizes were seen to encounter significantly higher spreading costs per hog than farms with larger herds. In some cases the extent of these costs will be sufficient to cancel out the positive value of the manure as a replacement for commercial fertilizer. It would therefore appear that significant savings might be realized if hog operators were to enter rental or custom arrangements for manure spreading. The overall conclusion reached in the study was that for Ontario conditions a land utilization program for the liquid manure supply does represent an economic means of handling the animal waste management problem.
(White-Iowa State)

## 0221-A4, A5, A8, C2, E2

**I AND DISPOSAL OF DAIRY FARM WASTE,**
Florida Univ., Gainesville. Dept of Agricultural Engineering.
A. R. Overman, C. C. Hortenstine, and J. M. Wing.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 123-126. 3 fig, 2 ref.

Descriptors: *Farm wastes, *Cattle, Dairy industry,

Effluent, Nitrogen, Phosphates, Soil contamination, Groundwater, Water pollution, Florida, Sprinkler irrigation, Rates of application, Nitrate, Oats, Waste disposal.
Identifiers: *Dairy cattle, Land disposal.

Wastes from 160 cows in a new milking barn at the University of Florida are collected in a 20,000-gallon holding tank and removed daily. An open impeller pump is used to deliver effluent to sprinkler guns which apply 1/4, 1/2, and 1 inch per week. The plots were seeded to oats, with no mineral fertilizer added. Measurements were taken to determine effectiveness of the oats in utilizing nutrients. Groundwater samples were extracted weekly at depths of 30,45, and 60 cm. for chemical analysis. Results are reported for nitrate and orthophosphate content. It is concluded that the soil plant system can be effective in renovation of waste water farm animal operations. Removal of nitrogen and phosphorus is greatly enhanced by plant growth. Nutrient removal was found adequate up to an application rate of 1 inch per week effluent with solids content of about 0.115 percent. It appears that a more intense application rate could be used. (White- Iowa State)

### 0222-A5, A8

**THE NITROGEN CYCLE OF A DAIRY FARM,**
Connecticut Agricultural Experiment Station, New Haven.
C. R. Frink.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 127-133. 4 fig, 1 tab, 11 ref.

Descriptors: *Nitrogen, *Nitrogen cycle, Farm wastes, Nutrients, Fertilization, Foliar application, Corn, Silage, Efficiencies, Nitrate, Groundwater, Ureas.
Identifiers: *Nitrogen conversion, Yield, Foliar fertilization.

Analyses of nutrient cycling on dairy farms in the Northeast have shown that significant quantities of nitrogen may be lost to groundwater. Calculations of the efficiency of nitrogen conversion on these farms revealed that losses to the environment increased dramatically as farm size decreased. Milk production was not affected by the increased nitrogen imported onto the farm while yields of corn silage increased only slightly. Thus, the total nitrogen imported onto the smaller farms could apparently be reduced without seriously reducing productivity. In addition, losses to the environment during cycling of the required amounts of nitrogen can be reduced by foliar applications to the growing crop, selection of varieties with high yield and nitrogen content, increased plant populations, and more extensive use of cover crops.
(White-Iowa State)

### 0223-A8, C2, E2

**NITROGEN TRANSFORMATIONS AND PLANT GROWTH AS AFFECTED BY APPLYING LARGE AMOUNTS OF CATTLE FEEDLOT WASTES TO SOIL,**
Southwestern Great Plains Research Center, Bushland, Tex.
A. C. Mathers, and B. A. Stewart.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 207-214. 8 fig, 2 tab, 3 ref.

Descriptors: *Farm wastes, *Cattle, *Nitrification, Denitrification, Nitrate, Nitrogen, Ammonia, Carbon dioxide, Greenhouses, Laboratories, Carbon, Rates of application, Incubation, Phosphorus, Potassium.
Identifiers: *Feedlots, *Nitrogen transformations, Pullman silty clay loam, Yield.

The objectives of these studies were: (1) to determine the decomposition rates and nitrogen transformations of animal wastes when applied to soil at various rates; and (2) to study the effects on plant growth of applying large amounts of animal wastes to soil. Studies were carried out with 0, 1, 2.5, 5, 10, and 20% rates of cattle feedlot waste added to Pullman silty clay loam in both laboratory and greenhouse tests. Three conclusions were reached: (1) When feedlot waste was mixed with soil, evolution of C and transformation of N were rapid. In 90 days, about 50% of the C was evolved as CO2 and an equivalent amount of N was recovered as NH3 evolved, or as NH4.. and NO3- in the soil. (2) Nitrification was influenced by application rate of manure and moisture content of the soil during incubation. (3) In a greenhouse study, one unit of N from ammonium nitrate was equivalent to 2.4 units of N supplied in feedlot waste.
(White-Iowa State)

### 0224-A2, A3, A4, A5, B1, C2

**HYDROLOGIC STUDIES FOR EVALUATION OF THE POLLUTION POTENTIAL OF FEEDLOTS IN EASTERN NEBRASKA,**
Department of Agriculture, Lincoln, Nebr.
Norris P. Swanson, Lloyd N. Mielke, and Jeffery C. Lorimor.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 226-232. 15 ref.

Descriptors: *Farm wastes, *Cattle, *Runoff, Overland flow, Surface runoff, Infiltration, Water pollution, Erosion, Evaporation, Discharge, Settling basins, Precipitation, Slopes, Storage, Time, Nebraska.
Identifiers: *Feedlots, Mulch, Water stage recorder, Manure pack, Intensity.

Four questions are discussed which arise as a result of large numbers of cattle contained in feedlots in eastern Nebraska. There were two primary objectives of the research. First, the annual water balance of the feedlots was to be defined. The second objective was to characterize the water leaving the feedlots in overland flow or by percolation through the profile. The data collected provide only rough comparison, but should serve to put the probable runoff, erosion, and infiltration, or retention of water on a feedlot into perspective with the better known hydrologic characteristics of cropped land. In eastern Nebraska, this can be summarized as follows: (1) Infiltration on an established beef feedlot appears to be restricted to water storage in the manure pack, with very limited water movement through the profile; (2) the runoff from a feedlot, and hence the pollution potential, is a function of the area of the lot; (3) annual runoff from a beef feedlot may be two or three times that of adjacent cropland, and (4) despite increased runoff in comparison adjacent cropland, the protective mulch of the manure pack keeps erosion losses below those of the cropland.
(White-Iowa State)

### 0225-A4, A5, A6, A9, F2

**LEGAL RESTRAINTS ON AGRICULTURAL POLLUTION,**
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
William R. Walker.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 233-241. 31 ref.

Descriptors: *Water pollution, *Farm wastes, Water Quality Act, Legislation, Discharge, Pesticides, Riparian rights, Odors, Zoning.
Identifiers: *Agricultural pollution, *Common law, State regulations, Federal regulations, Equity, Trespass, Liability, Nuisance, Negligence, Strict liability.

The basis is discussed for recovery under common law for agricultural pollution. These include actions for trespass, nuisance, negligence, and strict liability. However, agricultural pollution is not likely to be effectively controlled with private litigation. The federal government has the necessary legislation to play a leading role in agricultural water pollution abatement and it is designed to encourage the states to take a more aggressive role. Public awareness of the seriousness of the pollution problem in general is ever increasing. State laws banning the use of DDT, and HEW decisions to phase out the use of some of the persistent pesticides would indicate that public pressure for action in the field of agricultural pollution will be increasing. Thus there would seem to be little doubt that the law has a continuing and expanding role to play if agricultural pollution is to be controlled.
(White-Iowa State)

### 0226-A4, A9, C2

**A BALANCE SHEET METHOD OF DETERMINING THE CONTRIBUTION OF AGRICULTURAL WASTES TO SURFACE WATER POLLUTION,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Economics.
David A. Schultz.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 251-262. 8 tab, 9 ref.

Descriptors: *Water quality, *Farm wastes, *Nutrients, Nitrogen, Phosphorus, Potassium, Fertilizers, Water pollution, Sediments, Pesticides, Regions, Basins, Time.
Identifiers: *Balance Sheet Method, Nutrient losses, Biologic inputs.

To the extent that the data are accurate, the paper presents a Balance Sheet Method that will show explicitly the quantity of nutrients contributed by agricultural activities to a stream. From this, one can determine the relative importance of agricultural pollution given knowledge of the total amount of nutrient pollution. Combining this information with that available on water quality and contributions from other sources, a waste management association will be able to more accurately determine the share that the agricultural industry will have to pay of the total cost of a program to maintain an abundant quantity of good quality water for all uses. Using this general method as well as modifying and improving the procedure will aid society's efforts toward effective water pollution control for all rivers and lakes in the United States.
(White-Iowa State)

### 0227-A3, A8, E2

***RATES OF WATER INFILTRATION RESULTING FROM APPLICATIONS OF DAIRY MANURE,**
Cornell Univ., Ithaca, N.Y. Dept. of Agronomy.
P. J. Zwerman, A. B. Drielsma, G. D. Jones, S. D. Klausner, and D. Ellis.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 263-270. 6 tab, 17 ref.

Descriptors: *Farm wastes, *Cattle, *Infiltration, Time, Corn, Alfalfa, Wheat, Rotations, Rainfall simulators, Rates of application, Fertilizers, Sur-

face runoff, Rainfall.
Identifiers: *Dairy cattle, Intensity, Plots, Mass infiltration.

Sixty randomly selected plot locations were subject to infiltration tests with a rainfall simulator. Three successive tests of one half hour each were applied to the same plot. These results represent the effects of fourteen years of past management on seed beds prepared for corn. The rainfall rate was two and one half inches per hour. A two-by-two factorial and a two-by-four factorial experimental design were utilized. The two-by-two comparisons involved six tons of dairy manure plowed down versus no manure on continuous corn for grain at two rates of mineral fertilization. Manure increased infiltration by 27 percent, heavy mineral fertilization without manure on the last run resulted in a 60 percent decrease in infiltration as compared to manure with moderate mineral fertilization. The two-by-four factorial study again involved six tons of manure plowed down versus no manure on four rotations: (1) continuous corn for grain, (2) corn-oats-alfalfa-alfalfa, (3) corn-corn-oats-alfalfa-alfalfa, and (4) wheat-alfalfa-alfalfa-alfalfa-alfalfa. Manure did not significantly increase rates of infiltration. All rates of fertilization were very moderate. Only rotation No. 4 gave a significant 16 percent increase in rate of infiltration.
(White-Iowa State)

### 0228-A4, A5, A6, A7, B1, F2

**RAISING LIVESTOCK IN THE URBAN FRINGE,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. Ronald Miner.
Agricultural Engineering, Vol 51, No 12, p 702-703, December 1970.

Descriptors: *Odor, *Pollution abatement, Farm wastes, Pollutants, Legal aspects, Livestock, Planning management.
Identifiers: Urban-fringe.

More people in this country demand more and better-quality livestock production. However, the population is extremely sensitive to water and air quality. The livestock producer should recognize that there will soon be no livestock production area where environmental pollution is acceptable. All livestock production enterprises must be planned as though they will operate in the urban fringe. Livestock production units can and do cause pollution of the air and waterways if improperly managed. The most frequent complaint leveled at urban-fringe livestock production is that of odors. Through proper design and management the livestock operations may be made acceptable to the public. (Christenbury-Iowa State)

### 0229-A3, A4, A9

**THE FARM ROLE IN WATER QUALITY MANAGEMENT,**
Soil Conservation Service, Beltsville, Md.
Hollis R. Williams.
Water and Sewage Works, Vol 115, October 1968, p 463-464.

Descriptors: *Farm wastes, *Sediments, *Fertilizers, Insecticides, Herbicides, Water pollution, Watershed Protection and Flood Prevention Act, Channels, Cattle, Poultry, Pollution abatement.
Identifiers: Soil Conservation Service.

This article is based on information contained in an address by Williams to the Federal Water Quality Association. It is stated that three things find their way from farm lands into waterways to form major pollution problems. These are sediment, agricultural chemicals, and animal wastes. Sediment is the most significant of the three. Sediment also adsorbs phosphate and pesticides and carries them in streams. The major source of sediment is farmland, however, housing developments, new roads and other construction produces extremely large quantities of sediment. Four areas are mentioned which need continuing attention to control the erosion problem. The increased use of fertilizer is pointed out along its pollution capabilities. Research is currently being done to study the behavior of fertilizers, insecticides and herbicides on soils, water and plants. The problem of animal waste is also discussed. Four tools are pointed out as being necessary to achieve the goal of clean rivers and streams and successful control of pollution on farmlands as well as urban areas. (White-Iowa State)

### 0230-A2, A4, B1, C2, C3, D3, F1

**CATTLE WASTES - POLLUTION AND POTENTIAL TREATMENT,**
Kansas Univ., Lawrence. Dept. of Civil Engineering; and Kansas Univ., Lawrence. Environmental Health Engineering Lab.
Raymond C. Loehr, and Robert W. Agnew.
Journal of the Sanitary Engineering Division, ASCE, Vol 93, No SA4, p 55-72, August 1967. 2 fig, 9 tab, 29 ref.

Descriptors: *Farm wastes, *Cattle, *Water pollution sources, Rivers, Fishkill, Moisture content, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Anaerobic digestion, Oxygen demand, Lagoons, Hydrogen ion concentration, Effluent, Aeration, Sludge, Runoff, Waste water treatment.
Identifiers: *Feedlots, Cattle production, Pollution potential, Loading rages, Profit potential, Waste characteristics, Total solids, Population equivalent, Digesters, Anaerobic lagoons.

The problem of cattle feedlot waste treatment and the results illustrated in this paper can be summarized as follows: The diversified family farm is giving way to specialized large-scale factory-type operations such as beef cattle feedlots. Farm enterprises which formerly were dispersed over large remote land areas are now concentrated in small areas, frequently near communities, and intensify problems of waste disposal. Runoff from feedlots is a significant problem and treatment systems must be able to handle slug loads and flows without causing stream pollution. The profit potential and the amount of concern of the feedlot operator for adequate waste treatment will dictate the type of system that will be practical and economical. The quantity and the undesirable qualities of the wastes from a beef feedlot are such that a combination treatment system may be the most successful. A combined anaerobic-aerobic lagoon system has significant potential. The effluent from an anaerobic lagoon is potent and must receive further treatment before discharge to a receiving stream. Even after adequate removal of organics, the effluent may pose a problem because of its color and its fertilization capacity. (White-Iowa State)

### 0231-B2, B5, C1, C2, C3, D3

**THE INFLUENCE OF FEED ADDITIVES ON THE BIOCHEMICAL OXYGEN DEMAND ANALYSIS FOR SWINE WASTES,**
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
John David Ariail.
Master of Science Thesis, 1970. 72 p, 12 fig, 44 ref. OWRR Project A-048-NC (1).

Descriptors: *Farm wastes, *Hogs, *Lagoons, *Biochemical oxygen demand, Chemical oxygen demand, Water properties, Copper, Zinc, Wastes, Lagoons, Manure, Waste water treatment, Waste identification.
Identifiers: *Swine wastes, Swine feces, Chlorotetracycline, Fecal streptococcus.

The influence of feed antibiotic, chlorotetracycline, copper and zinc concentrations and sample dilution upon the standard 5-day biochemical oxygen demand (BOD5) analysis was investigated with swine feces, lagoon influent and lagoon effluent. The swine-growing center utilized for sample collection included a confinement facility with concrete floors that were washed daily and an unaerated overflow lagoon. The data indicated the mean COD/TS ratio for fresh swine feces to be 1.08 grams per gram, the BOD5/TS ratio to have a mean of 0.33 grams per gram, and the VS/TS ratio to have a mean of 0.82. This study indicated that for a 100 lb. hog, the daily COD in the waste was 0.64 pounds; BOD 0.31 pounds; total solids 0.48 pounds and volatile solids 0.33 pounds. The membrane filter technique outlined in Standard Methods for the determination of the fecal streptococcus content of swine wastes was superior to the membrane filter technique utilizing KF broth. (Miner-Iowa State)

### 0232-A2, A5, A8, B2, B3, C2, D3, E2

**CONTROL OF WATER POLLUTION FROM SOUTHWESTERN CATTLE FEEDLOTS,**
Texas Tech Univ., Lubbock. Water Resources Research Center.
D. M. Wells, W. Grub, R. C. Algin, G. F. Meenaghan, and E. Coleman.
Proceedings, 5th International Water Pollution Research Conference, July-August 1970, Paper II-38. 19 p, 20 tab. FWPCA Demr. Grant 13040, Texas Water Quality Board Contr. IAC (68-69).

Descriptors: *Farm wastes, *Cattle, *Manure, *Runoff, Biochemical oxygen demand, Nutrients, *Aerobic treatment, Anaerobic digestion, Irrigation, Waste water treatment.
Identifiers: *Feedlot runoff, Plant toxicity.

The objectives were to determine the characteristics of solid and liquid wastes resulting from cattle feedlot operations in the southwest U.S., to determine the treatability of these wastes by aerobic and anaerobic treatment systems and to determine whether or not the wastes produced could be used in a beneficial manner for the growing of cash crops. The feedlots studied included concrete-surfaced lots, dirt-surfaced lots, and controlled environmental chambers located on the Texas Tech University campus. Among their conclusions were that within reasonable limits, quality of runoff was not materially affected by type of ration fed or quantity of precipitation. Treatment of runoff resulting from precipitation on beef cattle feedlots is not feasible by conventional treatment systems. Direct application of runoff from concrete-surfaced lots was highly detrimental to the crops they tested. Direct application of runoff from dirt lots had an inhibitory effect on most crops tested except Midland Bermuda grass. Storage of runoff in unlined ponds may result in substantial pollution of the groundwater in the vicinity. They concluded that liquid systems for handling cattle feedlot wastes were not feasible. (Miner-Iowa State)

### 0233-A4, A5, A6, A7, A8, B2, C1, C2, C3, D3, E2

**EFFLUENT QUALITY FROM ANAEROBIC LAGOONS TREATING FEEDLOT WASTES,**
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Raymond C. Loehr.
Journal Water Pollution Control Federation, Vol 39, No 3, March 1967, p 384-391. 6 tab, 12 ref.

Descriptors: *Farm wastes, *Cattle, *Lagoons, Kansas, Biochemical oxygen demand, Odor, Dusts, Groundwater, Surface waters, Water pollution, Volume, Value, Soil environment, Temperature, Biodegradation, Anaerobic conditions, Mixing, Depth, Stabilization, Organic matter, Color, Nitrogen, Ammonia, Coliforms, Alkalinity, Hydrogen ion concentration, Equilibrium, Waste water treatment.
Identifiers: *Feedlots, *Anaerobic lagoons, Population equivalent, Slug load, Lagoon operation, Biological system, Surface area/volume ratio, Loading parameters, Volatile solids, Detention times.

Even under ideal equilibrium conditions, the liquid effluent from anaerobic lagoons treating livestock and feedlot wastes could pollute a receiving body of water. The quality of the effluent is decreased during the startup operations. The effluent is high in oxygen-demanding material, solids, and nitrogen. Subsequent treatment units are advisable to remove the solids and most of the oxygen-demanding material. Seasonal temperature variations will alter the effluent quality. The settled solids that need to be removed periodically from the anaerobic lagoon undergo considerable degradation, stabilization, and concentration. They are less potent than the entering untreated solids. However, their quality is such that they should not enter receiving waters. Land disposal offers an acceptable method of disposal for these solids. Anaerobic lagoons are not the complete answer to avoiding the pollution of natural waters by livestock and feedlot wastes. When used in combination with subsequent units to treat the effluent from the lagoons, anaerobic lagoons may be useful component process for livestock and feedlot wastes that have a high solids content. (White-Iowa State)

### 0234-A6,A12,B1,C2,C3,D1, E1,F1,F2

**FARM WASTES.**

Proceedings of Symposium, Farm Wastes, The Institute of Water Pollution Control, The University of Newcastle upon Tyne, 1970. 148 p.

Descriptors: *Farm wastes, Disposal, Legislation, Slurries, Composting, Disease, Legal aspects, Hazards, Toxicity, Public health, Odors, Costs, Design criteria, Treatment, Adsorption, Reverse osmosis, Confinement pens, Hogs, Equipment, Microorganisms, Farm lagoons, Irrigation, Aeration, Aerobic treatment, Anaerobic treatment, Biochemical oxygen demand, Chemical oxygen demand, Biological treatment.
Identifiers: Health, Public nuisance, Population equivalents, Swine, Slatted floors, Oxidation ditch, Flushing gutter, Systems, Gas production, United Kingdom.

The two day symposium was attended by over 200 delegates including representatives from local authorities, river authorities, universities, agricultural colleges and research stations, nationalized industries and consultants. The various Ministries were well represented, with over 60 delegates. Those attending included delegates from Canada, Denmark, Eire, Holland and the United States. Nineteen technical papers were presented. A discussion of each paper is included. Four sessions were conducted: An introductory session, 4 papers; Problems off the farm, 3 papers; Minimizing the waste problem, 7 papers; and Waste treatment and disposal on the farm, 5 papers.
(Christenbury-Iowa State)

### 0235-A1,B1,C2,C3,D3,E1, F1,F2

**ORIGINS AND NATURE OF FARM WASTES,**

National Agricultural Advisory Service, London (England).
K. B. C. Jones, and C. T. Riley.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 1, p 7-14, 1970. 9 tab.

Descriptors: *Farm wastes, *Disposal, Rain water, Costs, Cattle, Hogs, Poultry, Planning, Legislation, Legal aspects, Economics, *Waste disposal.
Identifiers: *United Kingdom, Washing-down water, Nature of waste, Population equivalents, Origins of waste.

Waste disposal is discussed in relation to population expansion, diminishing acres, declining numbers of agriculture workers, economic pressures, limited natural water resources, and legal pressures. The origin and nature of the wastes that must be disposed of is discussed. The trends in planning and disposal patterns taking place were considered. The costs associated with disposal were examined in relation to the income produced. Food processing waste has created some disposal problems for farmers. The disposal problems created by fruit and meat processing are discussed in the last portion of the paper.
(Christenbury-Iowa State)

### 0236-A4,A5,A6,B1,F1,F2, F3

**ORIGINS AND NATURE OF FARM WASTES: DISCUSSION,**

Gowan, Douglas.
Douglas Gowan.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 2, p 15-18, 1970. 1 tab.

Descriptors: Farm wastes, Disposal, Legislation, Discharge (Water), Sewers.
Identifiers: River authorities, Extensive farmer, Intensive farmer, United Kingdom, Public sewers.

Disposal of farm waste has become a major problem. A wholehearted effort is needed to deal with the problem, involving men, laboratories, and money. Also the farmers themselves must lend practical assistance. The law is there, and social and economic pressures are unlikely to ease. Nor is farming going to become less intensive, when this is the only way to profit, and the increasing public demand for food exists. All must combine to make sure that our inherent desire for increased water resources and pleasant-looking and smelling countryside facilities are one day realized.
(Christenbury-Iowa State)

### 0237-A8, B2, C2, E2

**THE PROBLEM OF DISPOSAL OF FARM WASTES, WITH PARTICULAR REFERENCE TO MAINTAINING SOIL FERTILITY,**

National Agricultural Advisory Service, Bristol (England). Soil Science Dept.
C. Berryman.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 3, p 19-23, 1970. 4 tab, 4 ref.

Descriptors: *Disposal, *Slurries, *Fertility, Farm wastes, Anaerobic conditions, Nutrients, Irrigation, Value, Fertilizers, Waste disposal.
Identifiers: *Animal slurry, *Composition, Organic irrigation.

This paper reviews the effect of farm waste, particularly in the form of animal slurry, on soil fertility. Slurry can supply an important part of the NPK requirements on the farm. The application of slurry to land is the most convenient and practical method of disposal, but problems due to a breakdown of soil structure can occur if an unsuitable soil receives excessive applications of slurry. The soil type is important when assessing the effect slurry disposal will have on the fertility of soil.
(Christenbury-Iowa State)

### 0238-A7, A11, B2, C2, C3, D3

**THE PROBLEM ON THE FARM: ANIMAL HEALTH,**

Ministry of Agriculture, Fisheries and Food, Norwich (England). Veterinary Investigation Service.
J. A. J. Venn.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 4, p 24-29, 1970. 41 ref.

Descriptors: *Toxicity, *Hazards, *Diseases, Farm wastes, Copper, Nitrogen, Potash, Lagoons, Slurries, Animal diseases, Bacteria, Viruses, Pathogenic bacteria.
Identifiers: United Kingdom, Toxic gases, Toxic chemicals, Parasites, Contamination, Health.

Health hazards associated with farm wastes have attained prominence with the development of intensive systems of husbandry. Whilst certain of the problems are unique to intensive systems, most of them are not new. This paper is an attempt to indicate some of them. An account is given of certain hazards to animal health arising from farm wastes, notably slurry and toxic chemicals. Possible ways of limiting these hazards are suggested. A discussion of the paper follows.
(Christenbury-Iowa State)

### 0239-A1, A6, A10, A12, B1, F2

**FARM WASTES: PUBLIC HEALTH AND NUISANCE PROBLEMS OFF THE FARM,**

Chelmsford Rural District (Essex). Chief Health Inspector.
T. H. C. Bartrop.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 5, p 33-37, 1970. 5 ref.

Descriptors: *Public health, *Legislation, Farm wastes, Odors, Diseases, Bacteria.
Identifiers: *Public nuisance, Noise, Rats, Flies.

All nuisances and public health problems are preventable. To achieve this it is necessary to couple good siting and good design with good animal husbandry. Failure to do this voluntarily must inevitably lead to stricter planning control and the strengthening of public health law, for the development of intensive farming has outstripped controlling legislation. Agriculture, as an industry, claims certain privileges, but it cannot claim the privilege of causing a nuisance or a public health problem. (Christenbury-Iowa State)

### 0240-A4, A5, E1, F2

**WATER POLLUTION PREVENTION REQUIREMENTS IN RELATION TO FARM-WASTE DISPOSAL,**

Thames Conservancy (England). Chief Purification Officer.
H. Fish.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 6, p 38-43, 1970.

Descriptors: *Farm wastes, *Legal aspects, Biochemical oxygen demand, Water pollution sources, Water quality control, Runoff, River regulation, Riparian waters, Groundwater, Legislation, *Disposal.
Identifiers: *United Kingdom, River authority, Common Law.

This article is concerned with the legal aspects of pollution and how they apply to agriculture. The ways in which farm waste can pollute water supplies and means of limiting the pollution effects are discussed. Large units located in close proximity to urban areas present the most difficult problems. Through cooperation between farmers and the river authority, the pollution effects of farm waste can be held at a minimum.
(Christenbury-Iowa State)

### 0241-B2,C2,C3,F1,F2,F4

**SEWERS AND SEWAGE TREATMENT,**

Chartered Civil Engineers, London (England); Newcastle-upon-Tyne Univ. (England).
James R. Simpson, and R. L. Hibberd.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 7, p 44-51, 1970. 2 fig, 2 tab, 13 ref.

Descriptors: *Costs, *Design criteria, *Sewage treatment, Farm wastes, Biochemical oxygen demand, Legislation, Dissolved solids, Tertiary treat-

ment, Sewers, Activated sludge, Capital cost.
Identifiers: River authority, Loading rates, Mogden formula, United Kingdom, Population equivalents, Suspended solids.

The purpose of this paper is to aquaint those unfamiliar with sewerage and sewage treatment with the general nature of the systems and processes. References to more detailed descriptions of the processes are included. Further, an attempt is made to answer the questions, 'Why and to what extent would a discharge with given characteristics affect the design of the sewers and the sewage-treatment works, and at what cost.' A formula for allocating waste treatment cost to agriculture is discussed. A discussion of the paper is included.
(Christenbury-Iowa State)

### 0242-B1, D1, D2, D3

**MINIMIZING THE WASTE DISPOSAL PROBLEM IN VEGETABLE PROCESSING,**
Electricity Council Research Center, Capenhurst (England).
F. Barrett.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 8, p 57-65. 7 fig, 4 tab.

Descriptors: *Apparatus, *Adsorption, *Reverse osmosis, Farm wastes, Desalination, Chemical oxygen demand, Recirculated water, Aeration, Flotation, Chlorination, Ultraviolet radiation, Biochemical oxygen demand, Equipment, Ozone, Biological treatment, Sludge disposal, Treatment.
Identifiers: *Food processing, Sterilization, Ozonation, United Kingdom, Vegetable processing.

This paper discusses possible mentods of treating waste from vegetable processing plants. The results obtained from a coagulation/flocculation unit have been encouraging. An aeration tower complex has been utilized for biological treatment. A pilot-scale adsorption unit and a reverse osmosis unit have been designed, built, and evaluated. A discussion and the reply to the discussion follows on page 106-109. (Christenbury-Iowa State)

### 0243-A6, B2, B3, C1, C2, E2, F1

**MINIMIZING POULTRY WASTE PROBLEMS,**
National Agricultural Advisory Service, London (England).
C. T. Riley.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 9, p 66-72. 3 fig, 5 tab, 1 ref.

Descriptors: *Farm wastes, *Poultry, *Disposal, Costs, Biochemical oxygen demand, Odor, Land use, Sludge, Chemical properties, Physical properties, Fertilizers.
Identifiers: Composition, Hatchery waste, Broilers, United Kingdom.

This paper is divided into two parts; first an assessment of the industry and second an approach to some current problems. Manure from cage layers represents the major disposal problem in the poultry industry today. The physical and chemical properties of waste is given. In the main, poultry waste has to be returned to the land in some form. The disposal of manure from laying batteries is discussed in relation to minimizing the poultry-waste problems. Whether to handle the manure as a solid or liquid is examined. A discussion and reply to the discussion follows on page 106-109.
(Christenbury-Iowa State)

### 0244-A6, B1, B2

**MINIMIZING THE WASTE PROBLEM WITH PIGS,**
National Agricultural Advisory Service, London (England).
C. G. Pointer.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 10, p 73-80. 7 fig.

Descriptors: *Confinement pens, *Design standards, *Hogs, Farm wastes, Slurries, Odor, Cleaning.
Identifiers: *Swine, Slatted-floor, Slurry systems, Sow feeders, Fattening house, Farrowing, United Kingdom, Manure handling, 'Ad-lib' feeding.

The first step towards minimizing the problems will be in the choice of site for the new pig unit. The larger the unit the more critical this decision will be. Subsequently the management and housing systems selected must be suited to the site. Systems have been described in this paper which minimize the problems. In existing problem units common sense and discretion can often avoid acute situations developing. It is hoped that economic solutions for these units will be evolved. In any event, there is always likely to be some smell from a piggery. A discussion and the reply to the discussion follows on page 106-109.
(Christenbury-Iowa State)

### 0245-B1, B2, E1, F1

**MINIMIZING THE WASTE PROBLEM WITH CATTLE,**
Newcastle-upon-Tyne Univ. (England).
M. M. Cooper.
Proceedings of Symposium: Farm Wastes: The Institute of Water Polution Control and The University of Newcastle upon Tyne. 1970. Paper No 11, p 81-83.

Descriptors: *Farm wastes, *Slurries, *Disposal, Cattle, Costs, Confinement pens.
Identifiers: *Cubicle system, Cowtels, United Kingdom.

This paper discusses some of the changes taking place in the cattle industry and the requirements for waste disposal. Many cattle producers require confinement areas for cattle for at least part of the year. Some of the systems being utilized for waste disposal are discussed. A discussion and the reply to the discussion follows on page 106-109.
(Christenbury-Iowa State)

### 0247-B2, B4, F1

**BUILDING DESIGN AND MANURE DISPOSAL,**
Institutt voor Landbouwbedrijfsgebouwen, Wageningen (Netherlands).
J. C. Glerum, A. P. S. De Jong, and H. R. Poelma.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 13, p 94-100. 3 fig, 3 tab.

Descriptors: *Farm wastes, *Disposal, *Costs comparison, Cattle, Storage tanks, Slurries, Storage capacity, Design criteria.
Identifiers: Mucking-out, Mixed storage, Separate storage, Animal housing, Cubicle house.

In general, slurry systems are preferable to systems for handling solids and urine separately. Special reasons, for example difficulty in disposing of the manure, can cause separate storage to be used. If mixed storage is used the layout of the buildings must be adapted to the specific requirements of this system. Altering the buildings afterwards will usually be very expensive. The high capital cost of the slurry system will often be a drawback; this is especially the case for cowhouses where a considerable storage capacity is required. A discussion and the reply to the discussion follows on page 106-109. (Christenbury-Iowa State)

### 0248-A11, B2, C2, C3, D3, E3

**PIGGERY CLEANING USING RENOVATED WASTES,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. J. Smith, T. E. Hazen, and J. R. Miner.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 14, p 101-105. 1 fig, 13 ref. Grant EC 00283.

Descriptors: *Disposal, *Equipment, *Oxidation lagoons, Farm wastes, Design criteria, Confinement pens, Management, Recirculated water, Anaerobic conditions, Slurries, Sludge, Microorganisms.
Identifiers: *Oxidation ditch, *Flushing gutter, Manure removal.

A full-scale study of the possibility of renovating swine manure for use in manure transport was carried out. Preliminary anaerobic treatment and settling took place in a lagoon followed by secondary treatment in an oxidation ditch. Measurements of COD, BOD, nitrogen, solids and certain inorganic salts were made during the period February to May 1969. Assessment of the results showed that the system had considerable promise from the standpoint of confinement house environmental improvement and labour reduction. A stable and sanitary effluent was obtained at all times which showed no adverse effects upon the performance of the animals exposed to it. Rainfall precluded useful information being obtained concerning salt build-up or toxicity in the treatment system. No toxicity effects were apparent after continuous operation for 20 weeks. The test was terminated because of mechanical failures. A discussion and the reply to the discussion follows the paper on page 106-109.
(Christenbury-Iowa State)

### 0249-B1, B2, B4, E2

**LAND DISPOSAL AND STORAGE OF FARM WASTES. 1. PLANNING AND CHOICE OF SYSTEM,**
National Agricultural Advisory Service, London (England). County Dairy Husbandry Adviser.
A. J. Quick.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 15, p 110-115. 1 tab, 6 ref.

Descriptors: *Farm wastes, *Disposal, *Effects, Slurries, Planning, Management, Dry farming, Storage, Equipment.
Identifiers: *Systems, *Comparison, Wash water, Wet farms.

This paper deals with the immediate problems facing the dairy farmer who finds himself in the economic squeexe, with the inevitable result that he will intensify his dairy enterprise. At the moment there is no universal solution to his problems, but they can be tackled, first by identifying the factors which will influence the choice of system (by factors are meant soil type, system of cow-housing, and unit size) and second, by selecting the most suitable system from the available alternatives. (Christenbury-Iowa State)

### 0250-B2, B3, B4, E2, F1

**LAND DISPOSAL AND STORAGE OF FARM WASTES. 2. HANDLING AND DISTRIBUTION,**
National Agricultural Advisory Service, London (England). National Livestock Mechanization Specialist.
J. I. Payne.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 16, p 116-121. 1 fig, 2 tab, 1 ref.

Descriptors: *Farm wastes, *Mechanical equipment, *Distribution, Slurries, Disposal, Treatment, Storage, Costs, Cattle, Irrigation.
Identifiers: *Handling, Removal, Solid manure, Organic irrigation.

The mechanization aspect of applying farm effluent to the land is governed by the physical state of the effluent, the stock housing system and the type of farm on which the stock enterprise is situated. Consequently three basic systems of handling manure onto the land have evolved. These are handling it as a solid manure, as a dense slurry, and as a diluted slurry. This paper discusses the equipment required for each of the handling systems. In general, if the manure can be kept solid the problems will be fewer. (Christenbury-Iowa State)

### 0251-B2, C2, C3, D3, E1

**AEROBIC TREATMENT OF FARM WASTES,**
North of Scotland Coll. of Agriculture, Aberdeen. Scottish Farm Buildings Investigation Unit.
K. Robinson, S. H. Baxter, and J. R. Saxon.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No. 17, p. 122-131. 1 tab, 9 fig, 26 ref.

Descriptors: *Aeration, *Mechanical equipment, *Aerobic treatment, Farm wastes, Odor, Slurries, Ventilation, Farm lagoons, Biochemical oxygen demand, Hogs, Chemical oxygen demand, Microorganisms, Dissolved oxygen, Laboratory tests, Waste water treatment.
Identifiers: Oxidation ditch, Aeration lagoon.

This paper is divided into two main sections - a review of existing commercially available methods of aerobic waste disposal and an outline of the project in Aberdeen for the study of pig-waste treatment. The review is limited to a description of aerobic methods and no specific attempt has been made to compare the relative merits of these systems, since a critical examination of some of them is one of the aims of our project. The characteristics of pig waste, its oxygen demands, and the influences of copper on bacterial activity are discussed. The factors influencing the growth and metabolic activity of micro-organisms are outlined and the problems of satisfactory methods of laboratory determinations are emphasized.
(Christenbury-Iowa State)

### 0252-A11, A12, B1, C2, C3, D3

**ANAEROBIC TREATMENT OF FARM WASTES,**
West of Scotland Agricultural Coll., Glasgow. Dept. of Bacteriology.
Selwyn Baines.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No. 18, p 132-137. 1 tab, 20 ref.

Descriptors: *Farm wastes, *Anaerobic digestion, Anaerobic conditions, Anaerobic bacteria, Microorganisms, Sludge, Slurries, Mixing, Hydrogen ion concentration, Biochemical oxygen demand, Digestion, Design data, Methane, Waste water treatment.
Identifiers: Commercial applications, Gas production.

This paper describes the effects of anaerobic treatment and its application to farm wastes. A satisfactory methane fermentation can be established and maintained. The digested sludge is relatively inert, free from nuisance and more amendable to dewatering. The anaerobic digestion process also reduces the risk of pathogenic organisms causing human or animal diseases. The design and operation of an anaerobic treatment process is described. Several reports from commercial installations are included. (Christenbury- Iowa State)

### 0253-D3, F1

**TREATMENT OF FARM WASTES,**
Instituut voor Landbouwbedrijfsgebouwen, Wageningen (Netherlands).
H. M. J. Scheltinga, and H. R. Poelma..
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 19, p 138-142. 3 tab, 3 fig.

Descriptors: *Farm wastes, *Biological treatment, *Aerobic treatment, Farm lagoon, Activated sludge, Aeration, Slurries, Biochemical oxygen demand, Sludge, Cost comparison, Waste water treatment.
Identifiers: Oxidation ditch, Pasveer ditch.

This paper is related to biological treatment of farm animal waste. Aerobic treatment is described. A schematic of an oxidation ditch and an aeration pit is included. The economic aspect of the oxidation ditch versus the aeration pit is presented. A discussion of the paper is included.
(Christenbury-Iowa State)

### 0254-D4, E3

**AEROBIC STABILIZATION OF BEEF FEEDLOT WASTE,**
Texas Tech Univ., Lubbock.
W. Grub, J. D. Martin, and L. L. Keeton.
Paper presented at the 1970 winter meeting American Society of Agricultural Engineers, Chicago, December 8-11, 1970, Paper No 70-909. 6 p.

Descriptors: *Anaerobic digestion, *Biological treatment, Farm wastes, Moisture content, Aerobic conditions, Oxygen requirements, Stabilization, Nitrogen, Waste water treatment.
Identifiers: *Composting, *Carbon to nitrogen ratio (C/N), Housefly.

Solid waste that had accumulated on Southwestern beef cattle feedlots was aerobically stabilized under controlled conditions in enclosed digesters and in open air piles. Conditions for stabilization were determined and changes of physical, chemical and biological characteristics were established. The organic stabilization of beef feedlot waste by composting is a feasible process. Organic beef feedlot waste is compostable in specially designed digesters or in exposed open air piles, to a biologically stable organic product, free from noxious odors and inset infestation. Stabilized waste can be stored in a wet or dry state without danger of heating, attracting insects, or causing noxious odors. The time of stabilization depends on the type of original feed material, the condition of the waste at the start of the composting period, and the management of the composting process. Composting requires skilled management to obtain satisfactory results. (Christenbury-Iowa State)

### 0255-A2, A4, B1, C1, C2

**EFFECTS OF MANURE DEPTH ON RUNOFF FROM SOUTHWESTERN CATTLE FEEDLOTS,**
Texas Tech Univ., Lubbock.
L. L. Keeton, W. Grub, D. M. Wells, G. F. Meenaghan, and R. C. Albin.
Paper presented at the 1970 winter meeting American Society Agricultural Engineers, Chicago, December 8-11, 1970, Paper No 70-910. 7 p, 2 tab, 1 ref.

Descriptors: *Rainfall intensity, *Rainfall-runoff relationships, Farm wastes, Pollutants, Moisture content, Biochemical oxygen demand, Chemical oxygen demand, Waste water treatment, Water pollution sources.
Identifiers: Feedlot runoff, Feedlot slope, Water holding capacity.

With the increasing number of beef cattle in feedlots in the Southwestern United States has come a major water pollution problem. The effects of manure accumulation on quantity and quality of runoff from concrete and direct surfaced feedlots for various precipitation rates were determined. A relatively dry manure pack holds approximately one-half inch of rainfall per inch of manure depth. If runoff from a relatively dry mass occurs, large quantities of suspended and dissolved pollutants are carried off. Manure at 60 percent moisture minimizes the pollutants removed during feedlot runoff. The quality of feedlot runoff is primarily a function of the moisture content of the manure, the rainfall intensity, and the feedlot slope. (Christenbury-Iowa State)

### 0256-A8, C2, D3, E2, F1

**USE ANIMAL MANURE EFFECTIVELY,**
Arizona Agricultural Experiment Station, Tucson.
J. L. Abbott.
Agricultural Experiment Station and Cooperative Extension Service Bulletin A-55, The University of Arizona. 3 tab, 1 fig, 6 ref.

Descriptors: *Farm wastes, *Fertilizers, *Rates of application, *Return (Monetary), *Beneficial use, Livestock, Arizona, Feedlots, Disposal, Costs, Salts, Nitrogen, Organic matter, Waste treatment.
Identifiers: Manure, Composting.

This publication discusses some important considerations that should be taken into account concerning the use of animal manure as a fertilizer. A possible $90-per-acre return for a $20-per-acre investment is being overlooked by many Arizona farmers. The cost of applying manure is in the order of $2 to $14 per ton up to a 40 mile haul. The fertilizer value of manure is at least $2 per tone for available N and P. The value of organic matter must account for the balance in cost. The greatest value of manure may result from the indirect effects of the organic matter contribution on the physical condition of the soil and in maintaining the availability of certain soil nutrients. The soluble salts in manure commonly range from 5 to 10 percent on a dry basis. Recommendations for manure are seldom more than 5 tons per acre annually. (Christenbury-Iowa State)

### 0257-A11

**DRINKING OF SULFATE-WATER BY CATTLE,**
Nevada Univ., Reno.
H. J. Weeth, and J. E. Hunter.
Journal Paper No 168. Journal of Animal Science, Vol 32, No 2, p 277-281, 1971. 1 tab, 39 ref. West Reg Research Project W-46.

Descriptors: *Sulfates, *Sodium chloride, Farm wastes, Cattle, Toxicity, Water, Growth rates, Water pollution effects.
Identifiers: *Drinking water, Sulfate water, Hemoglobin.

This study was designed to characterize some of the effects on cattle of drinking water contaminated with a known concentration of sulfate. Nine growing Hereford heifers were offered as drinking water either tap-water, 5,000 ppm Na sub 2 SO sub 4-water or 4,110 ppm NaCl-water. The experimental design was a 3x3 latin square with replicates. Experimental periods were 30 days. Total urine was collected on the last 7 days with renal clearance observations being made on the sixth day. The season was summer. The heifers drank less, ate less and lost weight while consuming the sulfate-water. The sulfate ion caused a relative diuresis. Percent urine water of free-water intake was 33.8 with sulfate-water, but only 22.1% with tap water. Total hemoglobin concentration was unaffected by the saline drinking waters, however, the sulfate-water caused a 450% increase in methemoglobin concentration and the development of 416.9 mg/100 ml of sulfhemoglobin. The two nonfunctional hemoglobins comprise 6.2% of total hemoglobin at this time. Drinking the sulfate-water increased serum sulfate concentration 63.1%, increased renal filtration of sulfate 45.2%, but decreased renal reabsorption of sulfate by 27.5%. Drinking sulfate-water did not alter plasma calcium concentration

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or renal excretion of calcium. A specific toxic effect of drinking the Na sub 2 SO sub 4-water was not apparent, however, the adverse effects seen were related to the sulfate ion. Only a slight polyposia and diuresis were observed with drinking of the NaCl-water. (Christenbury-Iowa State)

### 0258-C1, C2, C3, D2, D3, E3

**GAS PRODUCTION FROM BEEF CATTLE WASTES,**
Texas Tech Univ., Lubbock.
G. F. Meenaghan, D. M. Wells, R. C. Albin, and W. Grub.
Paper presented at the 1970 winter meeting American Society of Agricultural Engineers, Chicago, December 8-11, 1970, Paper No 70-907. 15 p, 9 fig.

Descriptors: *Anaerobic digestion, *Gases, Farm wastes, Chemical oxygen demand, Cattle, Carbon, Nitrogen, Hydrogen, Alkalinity, Methane, Biochemical oxygen demand, Waste treatment, Air pollution, Pollution abatement.
Identifiers: *Composting, *Gas production, Carbon to nitrogen ratio (C/N), Beef cattle, Carbonaceous material, Volatile acids.

A two-stage completely mixed isothermal digestion system having a capacity of 30 gallons/stage was fed wastes from a beef cattle controlled environment chamber. Gas production was monitored and analyzed by a wet test meter and a gas chromatograph, respectively. Physical and bio-chemical tests were also performed. This study indicates that a completely mixed, two stage anaerobic digestion system is technically feasible and can be used for obtaining nominal treatment of beef cattle wastes. Even with optimal conditions per stage such a system will not be sufficient for complete treatment. (Christenbury-Iowa State)

### 0259-A2,A4,A5,A6,B1,C1, C2,C3,D2,D3,F3,F4

**ANIMAL WASTES - A NATIONAL PROBLEM,**
Cornell Univ., Ithaca. Dept. of Agriculture; and Cornell Univ., Ithaca. Dept. of Civil Engineering.
Raymond C. Loehr.
Proceedings of the American Society of Civil Engineers, Journal of the Sanitary Engineering Division, Vol 95, No SA2. 9 tab, 4 fig, 86 ref.

Descriptors: *Farm wastes, *Anaerobic digestion, *Aerobic treatment, Dehydration, Environment, Cattle, Hogs, Poultry, Sheep, Diets, Odors, Ruminants, Weight, Nitrogen, Phosphorus, Potassium, Waste water treatment, Confinement pens, Digestion, Proteins, Moisture content, Physical properties, Density, Chemical properties, *Water pollution sources, Waste dilution, Slurries, Biochemical oxygen demand, Runoff, Ammonia, Chemical oxygen demand, Oxygen demand, Nitrates, Surface waters, Effluents, Coliforms, Incineration, Aeration, Farm lagoons.
Identifiers: *Animal production, *Population equivalents, Fiber content, Manure production, Nuisance potential, Feedlots, Oxidation ditch, Slatted floors.

A state of the art summary is presented on the control and management of animal wastes. Items discussed include the magnitude of the problem, pollution that has been caused by animal wastes, feasible treatment processes, major problem areas, and areas for future activity. Animal production and their subsequent waste production, properties, and characteristics are discussed first. The pollution and nuisance potential is then pointed out with respect to population equivalents. Waste treatment and disposal processes and systems follow. A summary and conclusion point out problems and what direction should be taken in the future. The paper was 86 references. (White-Iowa State)

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### 0260-C3, D3, E3

**GROWTH OF MICROORGANISMS IN FRESH CHICKEN MANURE UNDER AEROBIC AND ANAEROBIC CONDITIONS,**
Kentucky Univ., Lexington. Dept. of Agricultural Engineering; and Kentucky Univ., Lexington. Dept of Animal Science.
Sally W. Jackson, B. E. Langlois, and T. H. Johnson.
Poultry Science, Vol 49, No 6, 1970, p 1749-1750. 1 fig, 5 ref.

Descriptors: *Feeds, *Farm wastes, Poultry, *Aerobic conditions, Bacteria, Microorganisms, Laboratory tests, *Anaerobic conditions, Disposal.
Identifiers: Waste re-use, Uric acid, Ruminant feeds.

Utilization of animal manure as feed not only would provide a new source of protein for animals, but also would help to reduce the pollution of the environment. While use of such material as feed is not permitted at this time, research is necessary in order to determine the feasibility of using manure as feed in the event it is made legal. This study was made to determine whether microorganisms contained in chicken manure could utilize constituents of the fresh manure and increase in number during aerobic or anaerobic fermentation. Results suggested that fresh chicken manure contains substrates capable of supporting aerobic but not anaerobic growth of bacteria. (Hazen-Iowa State University)

### 0261-C1, C2, D3, E2

**ANAEROBIC DIGESTION OF FARM ANIMAL WASTES (DAIRY BULL, SWINE AND POULTRY),**
Wisconsin Univ., Madison. Dept. of Civil Engineering; and Wisconsin Univ, Madison. Dept. of Agricultural Engineering.
Lorne C. Gramms, L. B. Polkowski, and Stanley A. Witzel.
Transactions of the ASAE, Vol 14, No 1, January-February 1971, p 7-11, 13. 10 fig, 4 tab, 7 ref.

Descriptors: *Anaerobic digestion, *Farm wastes, *Digestion, Laboratory tests, Sludge, *Chemical Oxygen Demand, Poultry, Cattle, Gases, Hydrogen ion concentration, Alkalinity, Settling velocity.
Identifiers: Volatile solids reduction, Gas production, Volatile acids, Dentition time.

Dairy bull, swine, and pultry wastes are amenable to anaerobic digestion. Anaerobic digests for dairy bull waste may be loaded at rates of 0.24 pound VS per cubic foot per day with detention times between 10 to 15 days for good reduction in volatile solids and COD. Anaerobic digesters for pultry waste should not be loaded at rates greater than 0.18 pound VS per cubic foot per day with detention times between 10 to 15 days. Although substantial reductions may be achieved in volatile solids, and COD, the ultimate disposal of the wastes would still be a problem. If long term anaerobic digestion were used it would allow storage until the sludge could be spread on the land to obtain the optimum fertilizer value for land management. Of the three wastes studied the specific resistance of the poultry waste was the only value that was similar to the specific resistance of anaerobically digested domestic sludge. (Hazen-Iowa State University)

### 0262-A6, B2, B3, B4, D3, E2

**WASTE HANDLING: WHAT ARE THE CHOICES,**
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
O. I. Berge.
Hoard's Dairyman, Vol 116, March 25, 1971, p 353, 383. 1 fig.

Descriptors: *Farm wastes, *Waste water treatment, Waste disposal, Waste storage, Cattle, Odor, Fertilizers, Value.
Identifiers: *Waste handling, Waste utilization.

Waste disposal has long been a problem. Wastes must be removed periodically for good sanitation. For dairymen, the three major alternatives for handling manure are daily spreading, stockpiling for spreading when field conditions are more favorable, and liquid storage with spreading under more desirable conditions. All three systems depend on the availability of land for spreading within a reasonable distance of the cattle barn. No system of manure handling has been devised which is not likely to offend the nostrils of sensitive people. (Hazen-Iowa State University)

### 0263-B1, C1, C2, D3

**REMOVAL OF PLANT NUTRIENTS BY MEANS OF AEROBIC STABILIZATION OF SLUDGE,**
Illinois Univ., Urbana. Dept. of Microbiology; and Illinois Univ, Urbana. Dept. of Agricultural Engineering.
Roar L. Irgens, and H. Orin Halvorson.
Applied Microbiology, Vol 13, No 3, May 1965, p 373-386. 16 fig, 8 tab, 8 ref.

Descriptors: Chemical Oxygen Demand, *Biochemical Oxygen Demand, *Waste water treatment, *Sludge treatment, Sludge digestion, Denitrification, *Nutrients.
Identifiers: Digester supernatant fluid, Kjeldahl nitrogen.

In the convential treatment of sewage, the solids are normally disposed of by anaerobic digestion. This leaves a considerable amount of plant nutrients, such as nitrogen and phosphate, as soluble compounds which will eventually find their way into the plant's final effluent, since the supernatant fluid from the digesters is normally returned to the raw sewage. In a recent investigation, we found that, if the sludges were treated by an aerobic process, a significant portion of the carbonaceous matter was oxidized to carbon dioxide and water, and the rest was assimilated into microbial protoplasm. This process tied up the available nitrogen and phosphorus so that practically none remained dissolved in the suspending liquid. The accumulated solids, consisting mostly of microbial cells were separated very easily from the liquid leaving a slightly colored supernatant fluid that was water-clear, free from plant nutrients, and very low in BOD and COD. The overall process was accomplished in a detention time not exceeding 20 days, in contrast to anaerobic digestion which requires from 50 to 70 days. (Hazen-Iowa State University)

### 0264-B2, B4, B5, D1, D3, E1

**HANDLING METHODS FOR LIQUID MANURE ARE TESTED,**
D. W. Bates.
Hoard's Dairyman, Vol. 116, p 273, March 10, 1971, 3 fig.

Descriptors: *Waste disposal, Waste dumps, *Farm wastes, *Cattle, Storage tank, *Waste storage, Liquid wastes.
Identifiers: Barn heat.

Methods for handling liquid manure stored in a large external tank over an extended period of time were evaluated. The 150,000 gallon storage tank was constructed at a right angle to the end of a 60-cow tie stall barn. A cover of woven wire, polyethylene and baled straw was used in winter; the tank was uncovered in the summer. No conveyor system was installed. Waste heat from the barn's ventilation system was exhausted into the tank to prevent or reduce freezing. Pumps were used to level and remove the tank's contents. Conclusions are: (1) Manure stored in a large tank can be agitated and removed without difficulty under proper management; (2) Manure deposited in one end of a long tank will distribute itself sufficiently under its own weight so a conveyor is not necessary; (3) Waste heat from a barn's ventilation system is valuable in preventing freezing in an exposed manure storage tank. (Hazen-Iowa State)

### 0265-A11, A12, F2

**PENICILLIN BY THE POUND,**

Margaret E. Duffy.
Environment, Vol 11, No 8, 1969, p 14-21. 2 fig, 40 ref.

Descriptors: *Animal pathology, Disease resistance, *Diseases, Farm wastes, Beneficial use, Poultry, Regulation, Feeds, Cattle.
Identifiers: *Antibiotics, Agricultural uses, Growth promotion, Disease prevention, Hormones, *Penicillin, Drugs, Side effects, Therapeutic value, Hemorrhages, FDA.

Antibiotics, hormones and many other medicines used to treat human sickness have found their way into agriculture. The drugs are used to treat animal diseases, to promote growth, to preserve food and to protect plants. Far more antibiotics are used on farms than in hospitals, and the growing reliance on these and other medicines in agriculture raises a host of problems. The most serious of these may be the appearance of resistance in microbes to antibiotic treatment. Most of the antibiotics used in agriculture are added to the feed of cattle, pigs, chickens and lambs in order to promote growth. Antibiotics have had a greater effect on chickens and pigs raised in a previously occupied and therefore unsanitary environment than those raised in sanitized or new quarters. Prolonged feeding with antibiotics has more than once been reported to result in a decreased growth response in chicks. Antibiotics do not promote growth in germ-free animals. Some of the harmful side effects are: allergic and toxic effects of drugs, alterations in microbial flora which can cause disease and the development of resistant strains of micro-organisms. Animals may accumulate antibiotics in blood and muscle tissue when given antibiotics in their feed. Hence, antibiotics may find their way into meat products if animals are slaughtered before antibiotic residues have disappeared. (Hazen-Iowa State University)

### 0266-A6, A11, B2, B4, D3

**CAGED LAYER PERFORMANCE IN PENS WITH OXIDATION DITCHES AND LIQUID MANURE STORAGE TANKS,**

Guelph Univ. (Ontario). Dept. of Poultry Science.
J. P. Walker, H. L. Orr, and J. Poe.
Poultry Science, Vol 50, No 2, March 1971, p 501-505. 1 tab, 4 ref.

Descriptors: *Poultry, *Oxidation lagoons, *Confinement pens, *Performance, Waste disposal, Farm wastes, Waste treatment, Storage tanks, Slurries, Aeration, Equipment, Nitrogen, Odor, Design criteria.
Identifiers: Liquid manure, Egg production, Egg quality, Anti-foaming agent.

The increased size of poultry operations and the spread of urban areas has created problems in the disposal or utilization of poultry waste. These have been aggravated by the increased use of the liquid system of manure handling and its resultant odors. The purpose of this study was to evaluate the performance of caged layers housed in a pen utilizing oxidation ditches in contrast to caged layers housed in a pen with anaerobic liquid storage tanks. The conclusion is that hen housed egg production, egg quality, feed conversion and mortality performance of caged layers in pens with oxidation ditches was similar to that of caged layers in pens with liquid manure storage tanks. The odor in the pen with the oxidation ditches was less offensive than in pens with anaerobic liquid manure tanks. Modifications must be developed for oxidation ditches or other more economical means developed for oxidizing liquid poultry manure before it has practical application. (Hazen-Iowa State University)

### 0267-B2, B3, E2, F1

**WASTE MANAGEMENT...WHAT DOES IT COST,**

Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
Orrin I. Berge.
Hoard's Dairym[illegible], Vol 116, April 10, 1971, p 420. 8 tab.

Descriptors: *Waste disposal, *Cost comparisons, *Farm wastes, Cattle, *Costs, Cost analysis, Annual costs, Capital investment, Fertilizers, Value.
Identifiers: Cost factors.

This article is an economic protection of the cost factors involved in handling wastes by daily hauling, stacking or liquid manure. Daily hauling requires the least investment and liquid manure systems the most. The annual costs for each of the systems are much closer than the investment figures. The cost of the waste handling systems may be offset to a considerable extent by the fertility value of the wastes. (Hazen-Iowa State University)

### 0268-A2, B3, B4, F1

**MANURE STACKING.**

Hoard's Dairyman, Vol 115, October 1970, p 1028, 1067. 3 fig.

Descriptors: *Waste disposal, *Waste dumps, *Waste storage, *Farm wastes, Management, Equipment.
Identifiers Waste storage facilities.

The expense and problems involved with hauling wastes daily and the cost of liquid waste systems have caused agricultural engineers and dairy farmers to consider other ways of handling farm wastes, one of which is stacking. Unlike liquid waste systems, the amount of water that is mixed with the manure must be kept to a minimum. Another problem that may result with stacking is that of runoff from the stack itself. There is not the odor problem that exists in liquid systems. There are a number of stackers on the market; as it appears more dairymen will switch to stacking as a disposal system. (Hazen-Iowa State University)

### 0270-A11, C3, F6

**RAPID CONCENTRATION OF STRONGYLE EGGS FROM EQUINE FECES FOR IN VITRO STUDIES,**

Louisiana State Univ., Baton Rouge. Dept. of Veterinary Science.
Thomas R. Bello, and Virginia L. Gordon.
American Journal of Veterinary Research, Vol 31, No 12, p 2285-2288, December, 1970, 1 tab, 7 ref.

Descriptors: *Farm wastes, Laboratory tests, Nematodes, Eggs, *Separation techniques, Pollutant identification.
Identifiers: Equine, Horse, Laboratory procedures, *Strongyle eggs.

For in vitro studies, large numbers of strongyle eggs in equine feces were suspended, sieved, sedimented in water, and then floated in sucrose solution by centrifugation. The eggs were prepared for cultures by disinfecting with 1.2 to 1.3% sodium hypocholorite solution and washing in sterile Tyrode's solution containing antibiotics. This rapid concentration technique was 100.2 ± 2.2% efficacious based on eggs-per-gram (e.p.g.) fecal counts from 20 horses. (Christenbury-Iowa State)

### 0271-A8, E2

**GROWING CORN IN GROWTH CHAMBERS WITH DIFFERENT MANURE TREATMENTS,**

Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
Eugene Goering, R. I. Lipper, and H. L. Manges.
Unpublished Paper, Presented 1971 Mid-Central Meeting American Society of Agricultural Engineers, Paper No MC-71-104, 17 p, 10 tab, 6 ref.

Descriptors: *Farm wastes, *Crop response, Disposal, Laboratory tests, Plant tissues, Growth chambers, Cattle.
Identifiers: Manure, Application rates, Contamination.

The purpose of this experiment was to determine the effect on corn germination and early growth of different manure loading rates and to compare the effect of planting in manure mixed with soil against placement of seed above a manure layer. Germination and early growth of corn in plant growth chambers were adversely affected by applications of beef feedlot manure at rates ranging from 35 to 175 tons/acre, oven dry basis. The effects were different when manure was completely mixed with soil than when applied as a layer under a soil cover. (Christenbury-Iowa State)

### 0272-B1, F6

**A DOSING SIPHON FOR DISCHARGING CLEANING WATER INTO FLUSHING GUTTERS,**

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
H. L. Person, and J. R. Miner.
Unpublished paper presented at the 1971 Mid-Central Region Meeting American Society of Agricultural Engineers. Paper No MC-71-105, 22 p, 10 fig, 3 ref.

Descriptors: *Farm wastes, Design data, Equipment, Confinement pens, Test procedures, Theoretical analysis, Water pollution control.
Identifiers: *Flushing gutter, *Dosing siphon, Waste removal, Snifter.

An automatic dosing siphon has been designed, built, and used for discharging water into flushing gutters. An explanation of how the device operates as well as test data and design information are presented. The automatic dosing siphon is easy to design and build. The parts are commercially available. If proper precautions are taken to ensure that all joints are airtight, the automatic dosing siphon is a dependable device for discharging cleaning water into flushing gutters. (Christenburg-Iowa State)

### 0273-A4, A9, A11, B1, B5 C3, D3

**ROLE OF EXCRETED CHLORTETRACYCLINE IN MODIFYING THE DECOMPOSITION PROCESS IN FEEDLOT WASTE,**

Colorado State Univ., Ft. Collins. Dept. of Microbiology.
G. Keith Elmund, S. M. Morrison, D. W. Grant, and M. P. Nevins, Sr.
Bulletin of Environmental Contamination and Toxicology, Vol 6, No 2, 1971, p 129-131.

Descriptors: *Farm wastes, Biodegradation, *Biochemical oxygen demand, Bactericides, Toxicity, *Stabilization, Bioassay, Biological treatment, Diets, Water pollution effects, Feeds, Cattle, Ruminants, Pollutant identification.
Identifiers: Feedlot wastes, Dietary antibiotic, Rumen microflora, *Chlortetracycline.

Quantitative bioassays of fresh feedlot manure revealed that approximately 75 percent of the dietary chlortetracycline was excreted. The antibiotic concentration was 14 microgram g/gm of fresh feedlot manure, and 0.34 microgram g/gm of aged feedlot manure. Standard BOD5 values on manure from control steers and manures from steers receiving dietary chlortetracycline demonstrated that antibiotic supplementation of animal feeds may alter the microflora participating in the stabilization of feedlot manure. The effect of ingested chlortetracycline is two fold: (1) ingested antibiotic selects for a microbial population relatively inefficient in the stabilization process and (2) antibiotic supplementation apparently alters the digestive processes in the animal, resulting in manures which are less biodegradable as measured by the standard BOD5 procedure. (Christenburg-Iowa State)

### 0274-A4, A5, A9, B1, F1, F2

**POLLUTION, PESTICIDES AND THE PEOPLE - - AGRICULTURE AND OUR NATURAL ENVIRONMENT.**
Greater Des Moines Chamber of Commerce, Iowa. Agricultural Dept.

33rd Annual (Forum), National Farm Institute, February 11-12, 1971, Des Moines, Iowa, 107 p.

Descriptors: *Farm wastes, *Pesticides, *Sediment, *Water pollution effects, Fertilizers, Economics, Legislation, Water pollution control, Benefits, Costs, Agriculture standards, Water quality, Taxes, DDT, Population, Livestock, Environment, Sewage.
Identifiers: Conservancy districts.

The proceedings of the National Farm Institute include papers concerned with the various aspects of pollution and today's environment. Various pollutants which are discussed include farm wastes, fertilizers, pesticides, and sediment. In addition, other papers report on population aspects, legislation, economics of pollution control, and interest groups concerned with pollution. A wide array of views and potential control systems are examined.
(White-Iowa State)

### 0275-A1, A4, A5, F1, F2

**THE CITIZENS' VIEW OF POLLUTION,**
League of Women Voters of the United States, Washington, D.C. Environmental Quality Program.
Donald Clusen, Mrs.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 7-13.

Descriptors: *Environment, *Water pollution effects, Pollution abatement, Legislation, Governments, Research and development, Water quality, Standards, Water Quality Act, Taxes, Agriculture.

The author attempts to give societies view of pollution while admitting that the role of spokesman is a dangerous one. Trying to describe pollution or what it is constitutes a problem as varied as trying to prescribe solutions. There is no national consensus on environmental questions unless it is that a problem exists and the time to deal with it is now. An aroused public must insist that more be done, and faster, to abate pollution. Equally important is the preparation of a number of alternatives. Water resource development must be viewed as an integral part of the national effort to protect and improve the quality of man's environment. The general public has demonstrated that they want their money spent for pollution abatement. People want to have a voice in the choices to be made, they want to see some progress made, and they want environmental concerns to have a higher priority - in government, business and agriculture.
(White-Iowa State)

### 0276-A4, A5, A9, A11

**THE SPORTSMAN'S VIEW,**
National Wildlife Federation.
Phillip Douglas.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 15-22.

Descriptors: *Pesticides, *DDT, Water pollution effects, Conservation, Biodegradation, Recreation, Diseases, Beneficial use, Toxicity, Solubility, Fish, Birds, Biocontrol, Cultural control.
Identifiers: *Biological concentration, Primary effects, Secondary effects.

Both sides of the pesticide problem are presented in this paper. Pesticides, and in particular DDT, have been used successfully to help control typhus fever, malaria, and dutch elm disease among others. These beneficial effects are sometimes offset by their harmful residues. The DDT molecule combines four properties that are responsible for its behavior in the environment: (1) toxicity to almost all animal life; (2) persistence; (3) mobility; and (4) solubility properties. Many examples of fish and bird fatality are pointed out as the result of the accumulation of DDT. Usually these are the higher animals in carnivorous food chains. Twelve steps or courses of action are recommended to help alleviate the problem. (White-Iowa State)

### 0277-A4, A5, A9, F2

**THE FARMERS' CONCERN,**
Gilbert Stanek.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 23-29.

Descriptors: *Wastes, *Water pollution effects, Dieldrin, DDT, Mercury, Pesticides, Insecticides, Herbicides, Resistance, Research and development, Education, Regulation.
Identifiers: *Panic power, Mis-use, Tolerance level.

Farmers have four areas of concern in the environmental pollution field. The first is 'panic power' created by news media and other sources that cry out in unsure, uninformed voices about the uncertainties of pollution. The second area is mis-use or the improper handling of wastes and pesticides by farmers as well as non-farmers. The third area deals with tolerance levels. What criteria should be used and what levels should be set are questions which remain largely unanswered. The fourth area of concern to farmers is that they are a minority group. We are warned that if the American farmers' efficiency of production is jeopardized by banning of pesticide usage, the consumer will suffer through increased food prices because of reduced production. Research, education and regulation are key steps to preserve our standard of living.
(White-Iowa State)

### 0278-A4, A5

**POPULATION GROWTH RATE SHOULDN'T GET ALL THE BLAME,**
Bureau of the Census, Washington, D.C.
Conrad Taeuber.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 31-39.

Descriptors: *Human population, *Growth rates, Fertility, Fecundity, Census, Cities, Water pollution effects, Natural resources.

Population growth characteristics of the United States are pointed out. The growth rate is traced from pre-war times to present, with projections being made for future growth. Pollution and other social ills are not primarily a result of our rate of population growth. Changing standards and habits, in activities, technology, and the style of life have much more to do with the accumulation and disposition of waste materials and pollutants than does the number of persons involved.
(White-Iowa State)

### 0279-A4, A5, A8, A11, A12, B1, C2, E2

**POLLUTION - HOW MUCH OF A PROBLEM COMES FROM FERTILIZERS,**
Missouri Univ., Columbia. Water Resources Research Center.
George E. Smith.
In: 33rd Annual (Forum), National Farm Institue, February 1971, Des Moines, Iowa p. 40-48.

Descriptors: *Fertilizers, *Nitrogen, *Nitrate, Nitrite, Nutrients, Fertility, Toxicity, Eutrophication, Phosphorus, Water supply, Water walls, Runoff, Carbon dioxide, Oxygen, Photosynthesis, Water pollution, Soil contamination.
Identifiers: Metoglobenemia, Nitrate accumulation.

An objective view is given of fertilizer usage and its role as a pollutant. First concern for pollution from fertilizers was in connection with nitrate toxicity (metoglobenemia) in human infants and some species of livestock. Most of the water involved came from improperly constructed wells near livestock or where low rainfall caused nitrate accumulation in the soil from organic matters. Chemical fertilizers as well as city sewage, livestock wastes, and plant residues are all sources of nutrients which may cause eutrophication. Nitrate may accumulate in plant tissue to undesirable levels only under certain climatic and cultural conditions. A Missouri study of water supplies indicated that most nitrate contaminated wells were (1) in rural locations, (2) shallow, (3) poorly constructed, and (4) in areas where livestock production is the main source of farm income. There was a high degree of correlation between the occurrance and the concentration of nitrate in these wells and their proximity to livestock feeding areas or to septic tank tile fields. A final note is made of the corn farmer as an ecologist, whereby an acre of corn will use 10.5 tons of CO2 while producing 2.5 tons of plant material and 8 tons of oxygen - enough to support 12 people for a year. (White-Iowa State)

### 0280-A9, A12

**PESTICIDES,**
Environmental Protection Agency, Washington, D.C. Pesticide Advisory Committee,
William M. Upholt.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa p 49-56.

Descriptors: *Pesticides, *DDT, Diseases, Insecticides, Public health, Toxicity, Pesticide residue, Hazards, Poisons, Beneficial use, Water pollution effects.
Identifiers: *Parathion, Malaria, Cancer.

Pesticides are discussed with three main areas of emphasis. DDT is used as an example, but the principles are intended to apply to pesticides generally. The first area of emphasis is of the beneficial use of DDT. Increased production and the control of malaria are two main benefits. Human health hazards from pesticides are next pointed out. Death and illness have been attributed to pesticide poisoning. Currently the human health hazard that is most controversial is the possibility of cancer or birth defects from exposure to pesticide concentrations. Environmental hazards are the last area of concern. Biological accumulation and persistence in the environment are two main problems. The author suggest a drastic reduction in the use of DDT as one solution. Pesticides are useful, but they all carry some risk of damage to man or the environment. (White-Iowa State)

### 0281-A2, A4, A5, A6, B1, C1, C2, D1, D2, D3, E1, F4

**LIVESTOCK WASTE,**
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. Paul Taiganides.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 57-66, 1 tab.

Descriptors: *Farm wastes, *Cattle, Poultry, *By-products, Confinement pens, Water pollution effects, Odor, Organic matter, Moisture content, Runoff, Ammonia, Biochemical oxygen demand, Biological treatment, Drying.
Identifiers: *Animal production, *Coprology, Feedlots, Production efficiency, Waste properties, Population equivalent, Waste transport, Treatment processes.

A short comprehensive review is given of the changes in animal production and waste handling techniques. The transition from pasture to confinement production has met the demand for agricultural food and fiber. There has been a corresponding increase in animal waste management problems. This has given rise to what the author refers to as coprology - manure science. Current coprological technology includes knowledge of manure characteristics, transport methods, waste treatment and utilization schemes, and disposal media. Disposal must be done in such a way and at such a rate that nature will be able to assimilate it without creating environmental problems. (White-Iowa State)

### 0282-A3, A4, F3

**SEDIMENT: EVERYBODY'S POLLUTION PROBLEM,**

Soil Conservation Service, Washington, D.C.
Kenneth E. Grant.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 67-76, 1 tab, 8 ref.

Descriptors: *Sediment, Water pollution effects, *Sedimentation, Agriculture, Soil erosion, Right-of-way, Soil, Farm waste, Water quality, Watersheds, Flood damage, Value, Benefits, Soil surveys, Research and development, Land management.
Identifiers: Nonfarm sources, Soil Conservation Service, Soil capability, Universal Soil Loss Equation, Wind Erosion Equation, Mulch tillage, Conservation Needs Inventory.

Sediment is the nation's largest pollutant. It is not only a pollutant in itself, but a carrier of animal wastes and chemical pollutants. Examples of the enormity of the sediment problem are cited. Nonfarm sources of sediment are a serious and growing problem. The fight against soil erosion has been headed by more than 3000 local soil and water conservation districts in the United States. A Conservation Needs Inventory indicates that 63% of all privately owned land (cropland, pasture, range, forest, other) needs some type of conservation treatment. Examples of the effectiveness of conservation treatment. Examples of the effectiveness of conservation measures are given. Continuing research and cooperation is needed between agencies and the general public in the resource conservation area. (White-Iowa State)

### 0283-A3, A4, F1

**ECONOMICS OF POLLUTION CONTROL,**

Iowa State Univ., Ames. Dept. of Economics.
John F. Timmons.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 77-85.

Descriptors: *Environment, *Water pollution control, Economics, Natural resources, Standards, Programs, Costs, Benefits, Watersheds, Agriculture, Water pollution effects.
Identifiers: *Environmental quality, Goals, Quality standard, Suspended sediment, Production costs.

The paper suggests some ideas and methods that appear useful in understanding and in resolving some of the difficult but important issues emanating from three environmental quality questions. First, what are the standards of environmental quality that can serve as policy and program goals and at the same time engender wide spread and continuing public understanding and support. Next, what are the costs, both monetized and nonmonetized, of both achieving and failure to achieve the stated standards of environmental quality. Thirdly, who pays the costs both with and without achievement of the standards of environmental quality and who gets the benefits. Since environmental quality is a national issue, the author has endeavored to identify and elaborate upon these three major considerations in our quest for improvements in the quality of the natural environment. (White-Iowa State)

### 0284-A3, A4, F1, F2

**CURRENT CONSERVANCY LEGISLATION,**

Iowa House of Representatives, Des Moines.
Dale M. Cochran.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 87-93.

Descriptors: *Soil conservation, *Legislation, Wind erosion, Drainage, Soil erosion, Water pollution effects, Sediment, Rivers, Fertilizers, Pesticides, Agriculture, Iowa.
Identifiers: *Conservancy Districts, Des Moines River, District soil commissioners, Non-farm sources, US Department of Agriculture.

The scope and content of Iowa's Conservancy District bill is explained in this paper. The bill resulted after a review and study of drainage laws indicated that flood control, water pollution, recreation, soil erosion, and others were closely related. Conservation efforts have become rather static for a number of reasons, among them apathy, large operators, and shifts to continuous row crops. The Conservancy bill, as proposed, would regulate farm and nonfarm sources of erosion both by wind and water. The local soil conservation district commissioners would be in charge of soil conservation compliance. Cost sharing would be available for those required to comply. Failure to comply could result in a court order requiring immediate compliance and loss of any cost sharing funds that might have been available. (White- Iowa State)

### 0285-A4, F1, F2

**POLLUTION CONTROL DECISIONS - WHO SHOULD MAKE THEM,**

Resources for the Future, Inc., Washington, D.C.
Edwin T. Haefele.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 95-99.

Descriptors: *Water pollution control, *Pollution abatement, Governments, Legislation, Environment, Taxes, Water pollution effects, *Decision making.
Identifiers: Individual rights, Executive responsibility.

Four lessons have been learned in the developing history of our country to the problems of pollution control. The first lesson is the necessity for legislative determination of policy. Most environmental issues are not problems that can be solved but conflicts that must be resolved. Individual rights is the second lesson. All of us are exercising our individual rights to the detriment of all of us. Rightfull use by each individual is the central core of the problem of over use of common property resources. The need for executive responsibility is the third lesson. The fourth lesson involves connecting the notion of individual right with that of personal interest through the use of taxation and prices as regulatory devices. (White-Iowa State)

### 0286-A4, A12,

**AGRICULTURAL BENEFITS FROM URBAN POLLUTION CONTROL,**

Office of the Secretary of the Army, Washington, D.C.
John R. Shaeffer.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 101-107.

Descriptors: *Water pollution control, *Sewage treatment, Sewage, Benefits, Agriculture, Environment, Pollutants, Water pollution effects, Pumping, Viruses, Diseases, Fertilizers, Irrigation, Michigan costs.
Identifiers: *Environmental vision, Waste management, Treatment cells.

An environmental 'vision' is needed which encompasses the fact that the environment is a single interacting closed system, and that pollutants are potential resources out of place. Utilizing these ideas, a pilot waste water management scheme for Muskegon County, Michigan is outlined. Sewage is first pumped to the surrounding countryside where treatment calls convert the waste to an odorless clear liquid by using all the forces of nature - air, aerobic bacteria, gravity, sunlight, and time. The liquid is then used as irrigation water and the soil removes the remaining nutrients, heavy metals, and viruses. An under drainage system picks up the pure water and brings it to a stream. For 42 million gallons of Muskegon County sewage a day, 10 thousand acres of land were needed. The costs for the new system are less than bringing the existing plants up to a secondary level of treatment. (White-Iowa State)

### 0287-A6, B2, B3, B4, C2

**METHODS FOR DISPOSAL OF POULTRY MANURE,**

New Zealand Dept. of Agriculture, Christchurch.
P. D. Thompson.
New Zealand Journal of Agriculture, Vol 116, No 1, January 1968, p 44-49. 2 tab, 5 fig.

Descriptors: *Poultry, Fertilizer, Oxidation lagoons, Irrigation efficiency, Solid waste drying, Market value, Weight, Chemical analysis, Larvae, Waste treatment, Waste disposal.
Identifiers: *Cage, Broiler, Sewage sludge, Indoor lagoon, Droppings, Offensive smell, Breeding ground.

The disposal of poultry manure in its various forms can cause problems by the spread of the urban settlement. Disposal of poultry manure should be divided into three stages: the collection of droppings; the removal of the droppings; and the disposal or processing. The volume of poultry manure per 1000 laying birds per week is approximately 32 cubic feet per ton with a moisture content of 70 per cent. Approximately fifty acres of grassland is required to dispose of the annual manure produced from 2500 deep litter layers or 20,000 broilers. Sludge disposal is another method of handling manure. To handle the manure from 1000 birds at a dilution of 1:1, a holding capacity of 10 to 18 cubic feet per day is required. Most of these storage tanks do not exceed 1000 cubic feet. The disposal by irrigation is one of the common practices of emptying these tanks. Still another method of disposal is the lagoon. A newer method of disposal is drying the manure. This method is expensive, and therefore requires a sure market to be practical. Poultry farmers should realize the many profitable alternatives for the disposal of manure. (Bundy-Iowa State)

### 0288-A5, A8, B2, C2, C3, D3, E2

**FIELD CROP IRRIGATION WITH OXIDATION POND EFFLUENT,**

Mississippi State Univ., State College. Dept. of Agricultural and Biological Engineering; and Mississippi Agricultural and Forestry Experiment Station.
J. B. Allen, and J. C. McWhorter.
American Society of Agricultural Engineers, Paper No 71-246. 29 p, 10 tab, 8 fig, 12 ref. OWRR A-040-MISS (3).

Descriptors: *Oxidation lagoons, *Biochemical oxygen demands, Furrow irrigation, Rainfall, Wheat, Soybeans, Sudangrass, Clovers, Alfalfa, Mississippi crop yield, Nutrient requirements, Nitrogen, *Irrigation efficiency, *Water reuse.
Identifiers: Test plot, Coliform density.

The purpose of this 18-month study was to investigate the use of oxidation pond effluent for the irrigation of wheat, soybeans, sudax, alfalfa, and sweet clover in Mississippi. The study was conducted at the Agricultural and Biological Engineering Farm using effluent from a 2/3 acre oxidation pond located at the farm. All plots were furrow irrigated. Three irrigation treatments were used; irrigation with effluent, conventional irrigation, and no irrigation. A total of 23.8 inches of irrigation water was applied during the period from May 13, 1969 to October 29, 1970. The observed rainfall during this period was 81.95 inches, and the total of rainfall plus irrigation was 105.8 inches. At various times during the first growing season, samples of the effluent from the oxidation pond, the ground water beneath the plots, and stream flow from nearly sampling locations were collected for bacteriological and chemical analysis. The yield responses to both types of irrigation were small, probably because of a high ground water table at the plot location. There were no large yield responses resulting from the nutrients contained in the oxidation pond effluent. These nutrients were not sufficient to maintain a high level of crop production. (Bundy-Iowa State)

### 0289-A4,A12,C3,D2

**TREATMENT OF LONG ISLAND DUCK FARM WASTES,**

Cornell Univ., Ithaca, N.Y. Dept. of Sanitary Engineering.
Charles D. Gates.
Journal Water Pollution Control Federation, Vol 35, No 12, December 1963, p 1569-1579. 7 fig, 2 tab, 16 ref.

Descriptors: *Ducks, *Chlorine, *Coliforms, *Water management, *Chlorination, Farm wastes, Water pollution, Biochemical oxygen demand, Lagoons, Sludge, Waste disposal, Laboratory tests, Microorganisms, Salmonella, Effluents, Shellfish, Waste treatment, Oxidation lagoons.
Identifiers: Residual coliform densities, Underwater lagoon, Most probable number.

The presence of year round duck farms in the Moriches Bay area has resulted in pollution which interferes with other legitimate uses of these waters. A study was made and the results are reported in this paper. The conclusion is that the successful disinfection of duck farm lagoon effluents by chlorination would require a number of additions to, and changes in, present treatment practice. These would include (1) a separate basin to provide 15 minute contact time between the chlorine and the settled effluent; (2) facilities for adding the chlorine and thoroughly mixing it with the effluent; (3) some means of dose and/or residual control of the chlorination by the farm operator; (4) some administrative means of ensuring compliance with this required treatment. (Hazen-Iowa State)

### 0290-A11, C1, C2, C3

**CORYNEFORM BACTERIA IN POULTRY DEEP LITTER,**

Edinburgh Univ. Dept. of Bacteriology.
H. E. Schefferle.
Journal of Applied Bacteriology, Vol 29, No 1, 1966. p 147-160, 2 tab, 57 ref.

Descriptors: *Bacteria, *Poultry, Farm wastes, Hydrogen ion concentration, Laboratory procedure, Decomposing organic matter, Biodegradation, Salt tolerance, Organic acids, Ureas, Vitamin B, Ammonia, Genetics, Classification, Pollutant identification, Waste treatment.
Identifiers: *Coryneform bacteria, Litter, Uric acid, Biochemical characteristics, Growth factors, Deep litter, Build up litter.

A detailed discussion of bacteria found in poultry litter is presented. The most frequently occurring bacteria in poultry litter is the coryneform. The paper discusses the characteristics and classification of the coryneform bacteria isolated during the investigation. The procedures for isolating and differentiation of the various strains is discussed. The actual counts of coryneform bacteria in the region 10 to the 9th power - 10 to the 11th power/g of fresh material did not appear to be related to the physical conditions of the litter. Three hundred and eleven strains of coryneform bacterial were examined and compared to those found in poultry litter. (Hazen-Iowa State)

### 0291-C3

**COMPARISON OF MEDIA FOR ISOLATION OF SALMONELLAE AND SHIGELLAE FROM FECAL SPECIMENS,**

Center of Disease Control, Atlanta, Ga. Enteric Bacteriology Unit.
C. Dunn, and W. J. Martin.
Applied Microbiology, Vol 22, No 1, p 17-22, July 1971. 5 tab, 38 ref.

Descriptors: *Salmonellae, *Shigellae, *Pathogenic bacteria, Laboratory, Enteric bacteria, Bacteria, Isolation, Waste treatment.
Identifiers: Transport media, Plating media, Enrichment broth media, Bacteria population, Clinical specimens, Isolation rate, Recovery rate.

Five transport media, eight plating media, and three enrichment broth media for the isolation of salmonellae and shigellae were evaluated. Eight laboratories in widely separated regions of the United States participated in this evaluation by submitting 490 fecal specimens in the transport media provided. The results suggest that the newer transport media may not offer any advantage over the use of buffered glycerol-saline in the isolation of these enteric pathogens. Shigellae were best isolated by direct inoculation, whereas salmonellae were isolated in greater numbers after tetrathionate (without Brilliant Green) enrichment with subsequent culturing on the plating medium. The use of a variety of plating media is recommended for the recovery of a larger number of these enteric pathogens. (Bundy-Iowa State)

### 0292-A3, A4, A12, C1, C2, C3

**AGRICULTURAL LAND DRAINAGE AND STREAM POLLUTION,**

John M. Henderson.
Proceedings of the American Society of Civil Engineers, SA6, Vol 88, November 1962. 4 tab, 11 ref, p 61-75.

Descriptors: *Water pollution sources, *Biochemical oxygen demand, *Drainage effects, Public health, Waste water treatment, Zoonoses, *Farm wastes, Waste identification, Diseases, Runoff, Chemical properties, Physical properties.
Identifiers: *Human disease hazards, Organic pollution, Health hazards, Waste characteristics, Water-borne diseases, Population equivalents.

The inherent characteristics of organic pollution contributed to agricultural land drainage by farm animals are investigated as well as whether this contribution can be a significant problem in stream pollution. The nature of abatement measures is outlined, together with their practicability and effectiveness. Human diseases hazards in water-borne animal wastes are reviewed. (Christenbury-Iowa State)

### 0293-A9, A11, B3, C2

**SOUTHERN WORKERS REPORT RESEARCH,**

W. M. Smith.
Poultry Digest, March 1971, p 136-137.

Descriptors: *Eggs, *Effects, *Poultry, *Farm wastes, DDT, Phosphorus, Proteins, Confinement pens, Oysters, Calcium, Feeds, Amino acids, Wheat, Sodium.
Identifiers: *Egg shells, Egg quality, Egg production, Albumen, Chicken housing, Cow manure.

The text gives summaries of papers presented at a recent meeting of the Association of Southern Agricultural Workers at Jacksonville, Florida. Lighting eggs during incubation may hasten their hatching. Egg production drops after six weeks of feeding DDT at 1200 ppm; shell thickness and shell weight are reduced about 10%. Wire-floor-reared pullets were heavier at 4 and 20 weeks, laid better, and lived better than those raised on litter. Oyster shell strengthens egg shells. Caged hens require more sodium in the ration than do those on litter. (Hazen-Iowa State)

### 0294-A9, A10, C3

**MANURE MITES IN INTEGRATED FLY CONTROL.**

Poultry Digest, February 1971. p 68.

Descriptors: *Poultry, *Biocontrol, Mites, Farm waste, Larvae, Environmental effects, Population, Predation, Air temperature, Pollution abatement, California.
Identifiers: *Fly control, Mesostigmatid, Thinoseis spinosus, Fuscuropoda vegetans.

The manure mite is a biological control method in which a predator population eliminates a fly problem. Several species of mites have been found in California as being associated with the poultry industry. Some of the different mites being associated with flies on poultry ranches include Mesostigmatid mite, Thinoseis spinosus, and the Fuscuropoda vegetans. These mites do not get on people or birds, but they stay in the manure. They are most active in the winter, and can easily be seen on the surface of the manure when it cools off. The manure mite is a major predator on fly eggs. The manure mite in itself will not control flies, but can be used along with pesticides for control. (Bundy-Iowa State)

### 0295-A6, B2, C1, C2, C3, D3

**OXIDATION DITCH IN CAGE LAYER HOUSE.**

Poultry Digest, July 1971. p 337.

Descriptors: *Poultry, *Farm waste, Bacteria, Odor, Foaming, Water circulation, Solids, Waste treatment, Biochemical oxygen demand, *Waste water treatment, *Oxidation lagoons.
Identifiers: *Manure water mixture, Feathers, Mechanical failure, Cage laying house, Oxidation ditch.

An oxidation ditch under a laying flock presented no major problems during a two year study. This was a study made on a 936 bird caged flock in Northern Ireland. The oxidation ditch is 68 feet long with a channel width of 44 inches. The liquid depth is maintained between 3 1/4 to 3 1/2 feet deep for an approximate capacity of 1.8 cubic feet per bird. Waste production of the birds averaged 254 pounds per day with a biological oxygen demand of the fresh droppings of 40,860 parts per million. This was a daily B.O.D. load on the ditch of 10.3 pounds. It was necessary to empty the ditch completely when the solids content of the liquid rose above the 30,000 ppm level - about twice a year. Bacterial activity in the ditch during the first cycle of storage was responsible for loss of 43% of the total solids, 60% of the chemical and biological oxygen demand, and 66% of the nitrogen. The manure water mixture in the ditch was odorless. (Bundy-Iowa State)

### 0296-A6, A11, B1, C1. C3

**A NEW APPROACH TO CAGE WASTE DISPOSAL IN A CANINE LABORATORY,**

Veterans Administraton Hospital, West Roxbury, Mass. General Medical Research Dept.
P. Godin, and J. Belko.

Laboratory Animal Care, Vol 18, No 3, June 1968. p 401-404, 2 fig, 2 ref.

Descriptors: *Waste disposal, *Animal parasite, Laboratory, Labor, Moisture content, Water pollution control, Equipment, *Pollution abatement.
Identifiers: *Automatic flush waste system, Dog cage wastes, Compactness, Flushing.

The need for the improvement of animal housing to meet future standards prompted the design of a new type of animal cage at the Veterans Administration Hospital. This particular dog cage system has been in use for 3 years, housing 25 animals in a small area, yet meeting all the requirements for good animal care. The cages are custom-installed prefabricated fiberglass, featuring a central drain that ties into existing public sewer lines. An automatic flush system connected to the drain lines reduces both odors and labor. The general condition of the dogs have improved, and the number of parasites diminished with the way of cleaning. The relative humidity rises to 57% in the first hour after cleaning, then maintains a level of 47-50% throughout the day. This system may readily be adopted to existing or new animal facilities. (Bundy-Iowa State)

### 0297-A11, B1, B2, B4

**BROODER-GROW CAGES OVER DEEP PIT,**
Roland C. Hartman.
Poultry Digest, April 1971, p. 165-168.

Descriptors: *Poultry, *Farm wastes, Structural design, Ventilation, Waste storage.
Identifiers: Pit storage, Cages.

This article describes a brooder-growing house for pullets. The building measures 36' X 390' and has four 370' rows of double-decked cages on A-frames designed for starting 38,000 pullet chicks and rearing them until 20 to 22 weeks of age. The cages are set up over a deep pit. Air is exhausted from beneath the floor and brought in under the caves. Heat is supplied by a hot water pipe running down the center of each row of cages. (Parker-ISU)

### 0298-A2, A4, A6, B2, B4

**MANAGING SWINE WASTES TO PREVENT POLLUTION,**
Nebraska Univ., Lincoln. Agricultural Engineering Extension.
E. A. Olson.
Nebraska Farmer, April 1971, p. 18, 20, 22, 2 fig.

Descriptors: *Farm wastes, *Wastewater disposal, Lagoons, Waste storage, Settling basins, Hogs.
Identifiers: *Waste management, Nebraska Water Pollution Control Council.

The management of swine wastes to keep them from polluting our streams is one of the new production problems facing the swine producer. Site selection is especially important as related to odor problems and sufficient space for waste handling facilities. Runoff from swine lots must not reach streams. Therefore facilities must be built to store and dispose of wastes. This article discusses some systems and problems associated with swine waste disposal. (Parker-ISU)

### 0299-A2, A8, B2, E2

**HYDROLOGY OF SPRAY - RUNOFF WASTEWATER TREATMENT,**
Robert S. Kerr, Water Research Center, South Central Region, Federal Water Pollution Control Administration U.S. Dept. of the Interior, Ada, Oklahoma.
Richard E. Thomas, James P. Law, Jr., Curtis C Harlin, Jr.
Journal of the Irrigation and Drainage Division Proceedings of the American Society of Civil Engineers, Vol. 96, No. 3, 1970, P. 289-298. 4 tab, 4 fig. 15 ref.

Descriptors: *Hydrology, *wastewater treatment, *soil disposal fields, runff, systems analysis, water balance, water measurement, sprinkler irrigation.
*Identifiers: *Spray runoff, sprinkler application.

A 400-acre soil treatment system designed to treat 3.8 mgd of wastewater from a cannery was selected for a research study. Four watersheds with a total area of 11.4 acres were instrumented to evaluate the hydrology of the treatment system. The liquid measuring procedures used in the 12-month study accounid for 93% of the total liquid applies. On a monthly basis evaporative losses ranged from 9% to 35% of the liquid accounted for; and deep soil percolation ranged from 16% to 28% of the liquid accounted for. A change in the spray schedule from 6 hr per day to 8 hr per day and a reduction in the treatment area used from June through September suppressed but did not eliminate the effect of summer weather on the ratio of evaporative losses to runoff. During the 12-month study, evaporative processes accounted for 18% of the liquid; 61% returned to the surface stream as runoff; and 21% percolated through the soil. These values were obtained during a relatively wet year; therefore, evaporative losses could be expected to be relatively greater in normal and dry years. (Parker - ISL)

### 0300-A2, A6, A7, C3, D3, E2, F3, F4

**WASTE MANAGEMENT OF LIVESTOCK OF THE PLAINS STATES WITH EMPHASIS ON BEEF CATTLE,**
The Ad Hoc Interdisciplinary Committee on Feedlot Pollution of the Research Committee, Great Plains Agricultural Council.
The Research Committee by the Ad Hoc Interdisciplinary Committee on Feedlot Pollution of the Research Committee, Great Plains Agricultural Council, July 1969, pp. 1-11.

Descriptors: *Farm wastes, *livestock, odor, feedlots, air pollution, ammonia, sprinkler irrigation, lagoon, microbial, bacteria, runoff.
Identifiers: *Great Plains, Composting.

Representatives of the ad hoc committee met in Lincoln, Nebraska on February 10 to consider the charge outlined by the Research Committee of the Great Plains Agricultural Council: 'to study the scope and nature of current research on problems of feedlot pollution and to develop recommendations for consideration by the research committee at their next meeting." The ad hoc committee set up its organization at this meeting, outlined its procedure, identified sources of its information, and adopted the following resolution: "This Committee will be concerned with waste management of livestock of the Plains States with emphasis on beef cattle." At its second meeting on May 13 and 14, the ad hoc committee reviewed past and current research in the United States. It inventoried and discussed in detail the relevant research activity in th Great Plains. Problem areas were identified which, in the Committee's opinion, have special significance for the Great Plains and which appear to require additional research emphasis. This report summarizes the review of the national research effort and comments on its significance to research planners in the Great Plains. Current research in the Great Plains is outlined. Finally, this report states the Committee's recommendations for research emphasis in the Great Plains and for the establishment of a standing committeee to implement interstate coordination of research in waste management. (Bundy - ISU)

### 0301-B1, F2

**STATE AGENCIES REGULATING CONFINED ANIMAL FEEDING OPERATIONS,**
Environmental Protection Agency, Washington, D.C.
J. M. Sweeten.
Environmental Protection Agency Division of Technical Operations Open-File Report (TO 01.0 .543/1) 1971. 37 p.

Descriptors: *Farm wastes, Federal Government, *State Governments, Regulation, Control, Feed lots, Standards, *Administrative agencies.
Identifiers: *Regulatory control.

State Agencies that regulate livestock feeding operations and their responsibility with respect to environmental problems are identified. The reader will thus know which agencies should be contacted about establishing a confined feeding operation, improving or expanding existing feeding facilities, and reporting nuisances arising from feedlots. The information was collected by sending a letter to each State solid waste planning agency requesting: (1) the name and address of all State agencies that should be contacted prior to establishing a confined feeding operation; (2) the types and limits of control exercised by these agencies. The types of agencies exerting regulatory control over animal feeding operations in each State are summarized in a table. The availability of technical assistance in designing feedlot and waste treatment systems is included when specifically mentioned by the respondent agencies. General observations regarding nationwide control over animal feeding operations are made. (Bundy-Iowa State)

### 0302-A2, A12, C3

**SALMONELLA INFANTIS IN CATTLE FEEDLOT RUNOFF,**
Kansas State Univ., Manhattan. Dept. of Bacteriology.
J. R. Miner, L. R. Fina, and Cheryl Platt.
Applied Microbiology, Vol. 15, No. 3, May 1967, p 627-628, 1 tab, 10 ref.

Descriptors: *Farm wastes, *Runoff, *Pathogenic bacteria, Microorganisms, Cattle, Salmonella, Pollutant identification.
Identifiers: *Feedlot runoff, *Salmonella infantis, Litter.

Ten isolates of Salmonella infantis (serologically typed) were found in litter and runoff collected from two experimental feedlots near the Kansas State University campus. Pathogenic implications are discussed relative to recreation water sites. Agricultural runoff maybe a source of viable salmonellae. (Christenbury-ISU)

### 0303-A11, C2, F6

**METABOLIC FATE OF UBIQUINONE-7 Isolation and Identification of Metabolites in the Urine, Liver, Bile and Feces,**
Takeda Chemical Industries Ltd., Osaka (Japan). Biological Research Labs.
Takeshi Fujita, Shigeharu Tanayama, and Ziro Suzuoki.
Journal of Biochemistry, Vol. 69, No. 1, 1971, p 63-71, 9 fig., 2 tab., 17 ref.

Descriptors: Radioactivity, Urine, Laboratory tests, Chromatography, Chemical analysis, Chemical properties.
Identifiers: *Ubiquinone-7, Urinary metabolites, Acid chromatography.

The metabolic conversion of methoxy-14C-labeled ubiquinone-7 was investigated in the rat following intravenous injection. From urine two radioactive metabolites were isolated and identified. The major metabolite is a new compound whose structure is 2,3-dimethoxy-5-methyl-6 (3'-methyl)-1, 4-benzoquinone (compound B) whereas the other one is gamma-lactone of 2,3-dimethoxy-5-methyl-6- (5'-carboxypentyl-3'-hydroxy-3'-methyl)-1, 4-benzo-quinone (compound A). Compound B accounted for about half of the urinary metabolites and compound A a quarter. Both metabolites were excreted as conjugates into urine. About 90% of the hepatic radioactivity was identified as unchanged ubiquinone-7. Chromatographic examinations indicated the occurrence of compounds A and B in bile and feces, presumably as conjugates. The main biotransformation of ubiquinone-7 was thus proved to be oxidative shortening of the side chain. The chain with 7 isoprenoid units was eventually degraded to 3-carboxy-3-methylpropyl group in compound B via 5-carboxypentyl-3-hydroxy-3-methyl group in compound A, possibly due to Beta-oxidation of the latter. Metabolic conversion of ubiquinone-7 to ubiquinone-9 or ubiquinone-10 was not recognized in the present studies. (Hazen-ISU)

## 0304-A4, A6, A7, B1, C2, D3, E1, F1

### STATE OF THE ART REVIEW: TREATMENT AND DISPOSAL OF SWINE WASTES,

Mississippi State Univ., State College, and Soil Conservation Service, New Albany, Miss.
Adnan Shindala, and James H. Scarbrough.
Water and Sewage Works, Vol. 118, No. 2, p 50-57, February 1971. 2 fig, 4 tab, 44 ref.

Descriptors: *Odor, *Waste treatment, *Waste disposal, Chemical oxygen demand, Water pollution, Air pollution, Lagoons, Anaerobic digestion, Disposal, Farm wastes, Cattle, Confinement pens, Hogs, Biochemical oxygen demand, Alkalinity, Design criteria.
Identifiers: Odor production, Odor control, Environmental control, Swine, Characteristics, Loading rates.

Confinement production of animals yields large volumes of animal wastes which constitutes a tremendous oxygen demand on natural streams if not disposed of properly. Animal wastes disposal has become one of the major problems facing the livestock industry today. Among the many combinations of processes suggested for the treatment of animal wastes, lagooning has received the widest acceptance. The low cost of construction and operation of lagoons has resulted in their wide adoption for the treatment of all types of animal wastes. If properly located, designed, constructed, and maintained, anaerobic lagoons provide the most economical means of treating and disposal of swine wastes. Effluents from anaerobic lagoons are offensive and must receive further treatment. Anaerobic lagoons must only be used as an initial step rather than a complete facility and must be followed by other means of treatment prior to adequate and safe disposal of the effluents. (Hazen-ISU)

## 0305-A5, C2, D1, E2

### RETARDING EFFECT OF DESSICATION ON NITROGEN MINERALIZATION IN ORGANIC MANURES,

Indian Agricultural Research Inst., New Delhi. Div. of Soil Science and Agricultural Chemistry.
R. D. Laura, and M. A. Idnani.
Current Science, Vol. 40, No. 7, 1971, p 158. 1 tab, 3 ref.

Descriptors: *Drying, Nitrification, Nitrogen compounds, Nitrogen, Farm wastes.
Identifiers: Anaerobic fermentation, Microbial decomposition, Nitrogen mineralization.

Nitrogen in organic manures of animal or vegetable origin is complex in chemical nature due to its presence in the form of proteinaceous compounds which are largely insoluble in water. If such nitrogen is to be transformed to mineral forms which are easiy available to plants, the parent materials must be subjected to the agencies of decomposition in the soil. The effect of drying on the quantity of nitrogen mineralized in an animal manure, viz., dung spent-slurry is the object of an investigation. Sun-drying of spent-slurry has drastically reduced the rate of nitrogen mineralization. The reason may be irreversible desiccation of organic colloids of the manure on sun-drying and thus their increased resistance to subsequent microbial decomposition in soil. The conclusion is that apart from the chemical composition of an organic manure, the treatment given to it before applying to soil should also be taken into consideration while evaluating its nitrogen supplying power to growing plants. The practical implication is that to exploit full potential of the benefits that can be obtained from organic manures, they should never be subjected to drying before applying. (Hazen-ISU)

## 0306-B1, C2, C3, D3, E1

### ANAEROBIC DIGESTION FAILURES,

Bergen County Sewer Authority, Little Ferry, N.J.
Stanley A. Peterson, and Herman R. Zablatzky.
Journal Water Pollution Control Federation, Vol 40, No 4, p 581-585, April 1968. 2 fig, 5 tab, 3 ref.
Descriptors: *Anaerobic digestion, *Alkalinity, Lagoons, Hydrogen ion concentration, Waste water treatment, Sludge, *Sludge digestion, Digestion (Decomposition).
Identifiers: Isolation, *Ammonium alkalinity, Thickeners, Volatile acids, Gas production, Sodium hydroxide, Potassium hydroxide, Calcium oxide, Gas agitation.

Two separate incidents of digester failure are discussed, along with the materials and methods used to help them recover. Parameters of pH, alkalinity, CO2 content, volatile acids content, and gas production were continuously monitored and that data is presented in graphical form. Underconcentration of feed sludge may lead to failure by the depletion of alkaline buffering materials. Over concentration of feed sludge allows buildup of ammonium alkalinity to toxic levels. One of the essentials of good digester maintenance is early diagnosis of problems through close observance of the major parameters. Ideal sludge concentration varies from plant to plant and must be determined by the individual operator. (Lowry-Texas)

## 0307-A11, C3

### ISOLATION OF GRANULOSIS VIRUS FROM HELIOTHIS ARMIGERA AND ITS PERISTENCE IN ABIAN FECES,

Cape Town Univ., (South Africa). M. R. C. Virus Research Unit.
Hela Gitay, and A. Polson.
Journal of Invertebrate Pathology, Vol. 17, No. 2, p 288-290, 1971. 4 fig.

Descriptors: *Viruses, *Isolation, Farm wastes, Birds, Laboratory tests.
Identifiers: *Cattle egret, Procedure, Feeding habits.

This paper describes the procedures by which a granulosis virus was isolated. Feces of the Cattle egret, Arboela ibis, that feed on the caterpillars of the bollworm and the lucerne caterpillar were collected and found to contain intact inclusion bodies of granulosis virus but no polyhedra. The granulosis virus was isolated from the bollworm caterpillars, Heliothis armigera. (Christenbury-ISU)

## 0308-B2

### DEEP PIT SLAT-FLOOR BREEDING HOUSE,

Roland C. Hartman.
Poultry Digest, December 1970, p. 580-583. Fig. 7.

Descriptors: *Poultry, *Farmwastes, Ventilation, Design data.
Identifiers: *Slatted floor, Evaporative cooling.

This is a description of a slatted floor confinement house for poultry breeding flocks. The building has a 6 feet-5 inches ceiling height room above a 6 feet-0 inch pit, all above ground level. Slats are made of 2 X 4's split to 1 7/8 inches X 1 7/8 inches. Fans draw air from the pit area. The air enters through continuous vents near the ceiling passing first through an evaporative cooler made of a fogger and cooling pad. INCHEShese units were built by Pace/Setter Inc. on the high desert near Hesperia, California. (Parker-ISU)

## 0309-A6, A7, C1, D1, D2

### CONTROL OF POULTRY HOUSE EXHAUST ODORS,

USDA Agricultural Research Service.
George B. Willson.
Poultry Digest, p. 332-334, July 1971. 2 fig., 1 tab., 4 ref.

Descriptors: *Poultry, *odors, *particle size, air circulation, waste treatment, drying, wetting, air pollution effects, waste.
Identifiers: *Air filter system, water scrubbing, masking agents, ammonia-like odor, respirator.

Filtering exhaust air from poultry houses will reduce the odor. Pad-type filters were effective in removing the dust and reducing the odor, but clogged too quickly to be practical. Baffle impingement filters were evaluated for dust and odor control. The effectiveness of removing the dust and odor was improved when the vanes were washed clean. The study was conducted at Uniontown, Maryland in three 12,000 bird windowless caged laying houses. The spray of .8 gallons per minute per hen was required for the best results. The water was recycled through a storage tank to reduce the amount of water required to operate the system. It was concluded that water spray chambers can reduce substantially the odor exhausted from the building. Studies also showed there is not a direct relationship between dust and odor. (Bundy-Iowa State).

## 0310-C1, C2, D2, F6

### IMPROVEMENTS IN THE COLLECTION OF HYDROGEN SULFIDE IN CADMIUM HYDROXIDE SUSPENSION,

Washington State Univ., Pullman. Coll. of Engineering.
W. L. Bamesberger, and D. F. Adams.
Environmental Science and Technology, Vol 3, p 258-261, 1969. 2 fig, 3 tab, 11 ref. Grant No. AP-00215 Division of Air Pollution, U.S. Public Health Service.

Descriptors: *Hydrogen sulfide, *Oxidation, Chemical reactions, Analytical techniques, Ions, Laboratory tests, Efficiency performance, Colloid suspension, Hydrogen ion concentration.
Identifiers: *Cadmium hydroxide, Absorption solution, Aspirator, Alkaline solutions, Jacobs method.

The technique of collecting hydrogen sulfide at ambient air concentrations in cadmium hydroxide suspension, in use for more than 10 years, is reported to prevent loss from sulfide oxidation. A comparison of this procedure with bromine microcoulometric titration and with calculations of the anticipated hydrogen sulfide concentrations produced in a laboratory gas dilution system revealed an unpredictable and nonreproducible loss of hydrogen sulfide as high as 80% during collection of a 2-hour impinger sample containing cadmium hydroxide suspension. Evidence is given of the photodecomposition of cadmium sulfide in the impinger and techniques are described to reduce loss of sulfide during sampling and storage. The suggested modification provides reproducible hydrogen sulfide recoveries. Reliable quantitative results were obtained. (Bundy-Iowa State)

## 0311-A6, A7, C3, DJ

### WHY STIRRING MANURE REDUCES ODORS,

Pennsylvania State Univ., State College. International Poultry Industries Exposition.
Glenn O. Bressler.
Poultry Digest, p 60, February 1971.

Descriptors: *Anaerobic condition, *Air circulation, *Aeration, Anaerobic condition, Odors, Bacterial, Drying, Gases, Velocity, Movement, Air pollution, *Farm wastes, *Waste treatment.
Identifiers: Sewerage gas, Anaerobic bacteria.

Anaerobic bacterial action is the primary cause of the offensive odors in manure. High velocity air circulating over the droppings hinders the bacterial action and reduces the odor. However, the high velocity air movement over the manure does not stop the bacterial action underneath the surface. To rid the odor producing gases from forming, the anaerobic bacteria must be destroyed. By aerating with fans and stirring several times daily, most of the anaerobic bacteria are destroyed. This combined operation destroys the odor as well as increases the speed of drying the droplets. (Bundy-Iowa State)

## 0312-C2, F6

**REDUCTION AND ESTERIFICATION OF CHOLESTEROL AND SITOSTEROL BY HOMOGENATES OF FECES,**
Montefiore Hospital, Bronx, N.Y.
R. S. Rosenfeld, and L. Hellman.
Journal of Lipid Research, Vol 12, No 2, 1971, p 192-197. 4 tab, 23 ref.

Descriptors: *Lipid, Microorganisms, *Waste treatment, Incubation, Aluminum compound, Waste water treatment, Acids.
Identifiers: *Cholesterol, *Sitosterol, *Feces, Free sterols, Bile acid, Estification.

Mixtures of cholesterol-1,2-3H and sitosterol 4-14C have been incubated with suspensions of feces in order to compare the behavior of the phytosterol with transformations known to take place with cholesterol under these conditions. Within the limitations of the study both labeled sterols were esterified to the same extent, and reduction of the delta 5 double bond to the saturated analogue proceeded equally in both substances. After correcting for procedural losses, the recoveries of 3H and 14C from the incubations were always less than the controls; this strongly indicates destruction of sterol by feces microorganisms. (Bundy-Iowa State)

## 0313-B1, C1, D1, D2, F1

**TYPES OF MANURE DRYERS,**
Poultry Digest, p 338-340, July 1971.

Descriptors: *Poultry, *Farm wastes, *Drying, Capital investment, Moisture content, Dehydration, *Waste treatment.
Identifiers: Rotary dryers, Conveyor dryers, Vibrating conveyor dryers, Vibrating type conveyor, Three pass drum, 2 stage drying.

With the increase in demand for poultry manure drying, several dryers operating on different principles have been put on the market. One type of dryer subjects manure to 1400 degrees of temperature in a rotating drum. Another type dryer uses the conveyor principle. The conveyor-type unit pulls the manure back and forth through a unit with air temperatures of 400 to 600 degrees. A modified version of the conveyor type vibrates. This is a new type expected to be on the market during the summer of 1971. The temperature ranges from 1000 degrees at the start and drops to 400 degrees. A three-pass drum method of drying utilizes hot gas temperatures up to 1800 degrees, and allows 75 feet of horizontal travel in a 25 foot drum. A two stage drying method is being promoted which will reduce the drying cost. The first stage uses mechanical stirrers on the manure aided by a high velocity air current. This first stage reduces the moisture without applying heat to the manure. While the second stage process drys the manure down to the desired moisture content. The two stage process allows more manure to be dryed or allows for a smaller dryer. (Bundy-Iowa State)

## 0314-A6, A7, B1, C2, C3

**GASES AND ODORS FROM POULTRY MANURE: A SELECTED BIBLIOGRAPHY,**
Merck and Co., Rahway, N.J. Quinton Research Labs.
W. E. Burnett.
Poultry Science, Vol 50, No 1, p 61-63, January 1971. 35 ref.

Descriptors: *Poultry, *Odor, *Gases, *Farm wastes, *Bibliographies, Research and development, Management.

This is a bibliography of 35 articles pertaining to gases and odors from poultry wastes. The articles are grouped into three divisions: (1) The microbiology and chemistry of gas and odor production; (2) Identification and determination of gases and odors; (3) Odor control methods. (Hazen-Iowa State)

## 0315-A9, E2, F3

**IF COW MANURE BREAKS DOWN DDT. . . ,**
R. C. Hartman.
Poultry Digest, March 1971. pp. 100.

Descriptors: *DDT, Farm wastes, Poultry, Insecticides.
Identifiers:* Decomposition, DDT, build-up.

Cow manure reportedly breaks down DDT in the soil in a few weeks. The question is raised as to whether poultry manure will work as well. Studies need to be made to determine whether it is necessary to use fresh poultry manure to degrade DDT, or whether processed manure can do the same job. (Hazen—Iowa State)

## 0316-A6, A7, A11

**EFFECTS OF ATMOSPHERIC AMMONIA ON THE PIG,**
Ohio Agriculture Research and Development Center, Wooster. Dept. of Agricultural Engineering; and Ohio Agriculture Research and Development Center, Wooster. Dept. of Animal Science.
D. P. Stombaugh, H. S. Teague, and W. L. Roller.
Journal of Animal Science, Vol 28, 1969, p 844-847. 2 fig, 2 tab, 7 ref.

Descriptors: *Hogs, *Ammonia, Air pollution, *Air pollution effects, Toxicity, Ventilation, Farm wastes, Confinement pens, Odor, Gases, Growth rates, Laboratory tests.
Identifiers: *Response, Anhydrous ammonia, Feed consumption, Feed efficiency, Concentration, Exposure time.

Duroc pigs were subjected to four levels of ammonia air contamination. Ammonia concentration had a highly significant adverse effect upon feed consumption and average daily gain. There was no significant effect upon efficiency of feed conversion. Corynebacterium and Pasteurella were isolated from the ethmoid turbinates of two animals, otherwise all gross, microscopic and bacteriological observations were unaffected by ammonia concentrations. Frequency of coughing was increased in animals exposed to the higher ammonia levels. (Hazen-Iowa State)

## 0317-A6, A7, A12, D1, D2, E1

**AIR POLLUTION ASPECTS OF ODOROUS COMPOUNDS,**
Litton Systems, Inc., Bethesda, Md. Environmental Systems Div.
Ralph J. Sullivan.
Available from the National Technical Information Service as PB-188089, $3.00 in paper copy, $0.95 in microfiche. September 1969. 245 p, 3 fig, 444 ref. Contract No PH-22-68-25.

Descriptors: *Odor, *Air pollution effects, *Classification, Air pollution, Air environment, Pollution abatement, Costs, Property values, Farm wastes, Effects, Public rights, Theoretical analysis, Economics.
Identifiers: *Odor perception, *Sources, Detector, Nose, Description, Characteristics, Intensity, Acceptability, Public opinion, Allergies.

Offensive odors provoke people into complaining about air pollution. They may cause both mental and physiological effects such as nausea, headache, loss of sleep, loss of appetite, impaired breathing, and in some cases, allergic reactions. The most offensive odors come from Kraft paper mills, animal rendering plants, chemical plants, petroleum refineries, diesel engines, sewers and sewage treatment plants, and metallurgical plants. The most generally accepted method for abating most odor pollution problems is incineration. Other methods of control include: adsorption, chemical scrubbing, containment, process changes, and masking or counteracting the odors. The cost of abatement depends on the odor pollution problem and the source. The human nose is the only reliable odor detector. (Christenbury-Iowa State)

## 0318-A2, A8, B2, C2, F1

**RUNOFF, SOLID WASTES, AND NITRATE MOVEMENT ON BEEF FEEDLOTS,**
Agricultural Research Service, Lincoln, Nebr.; and Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
C. B. Gilbertson, T. M. McCalla, J. R. Ellis, O. E. Cross, and W. R. Woods.
Journal Water Pollution Control Federation, Vol 43, No 3, Part 1, p 483-493, Mar 1971. 11 p, 2 fig, 6 tab, 18 ref.

Descriptors: *Farm wastes, *Water pollution sources, *Path of pollutants, *Confinement pens, Runoff, Water quality, Nitrates, Groundwater, Surface waters, Water pollution, Industrial wastes.
Identifiers: *Feedlot wastes.

A study of the effect of feedlot slope and cattle densities on the quantity and quality of runoff resulting from rainstorms and snowmelt, the downward movement of pollutants into the soil profile on unpaved feedlots and the amount of solids accumulation on the feedlot surface revealed that feedlots with 18.58 sq m/head yielded 5.6 metric tons dry matter/day/ha, whereas those with 9.29 sq m/head yielded 7.6 metric tons/day/ha. Feedlot slope had little effect. About 30 percent of the solids were volatile. Runoff quantity and quality depended more on rainfall than slope or cattle density, but high-density lots yielded 130 to 170 percent more winter runoff than low-density lots. Winter runoff averaged 6.2 to 17.6 metric tons/ha-cm, with about 50 percent volatile. Nitrate movement in soil after 1 yr was minimal. (Knapp-USGS)

## 0319-A6, A8, B2, B3, C2, D1, D2, D3, E1, E2, E3, F4,

**FARM WASTE DISPOSAL SYSTEMS,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
A. C. Dale.
Cooperative Extension Service, Purdue University, AE-80, Feb 1971. 10 p, 1 tab, 5 fig, 34 ref.

Descriptors: *Farm wastes, *Waste disposal, *Lagoons, *Oxidation lagoons, Aerobic conditions, Anaerobic conditions, Algae, Organic matter, Volume, Drying, Odor, Nitrogen, Aeration, Hogs, Cattle, Poultry, Research and development, Soil, Soil contamination.
Identifiers: *Disposal systems, *Land disposal, Oxidation ditches, Aerated lagoons, Composting, Refeeding, Anhydrous ammonia, Waste characterization.

In this publication the present available alternatives for animal waste disposal and criteria for selection of these methods are presented. A brief literature review tells of research being done in all areas and aspects of animal waste disposal. Land disposal still remains the most suitable and most widely used disposal method. Research indicates that approximately 250 pounds of nitrogen can be added to each acre of soil without unduly polluting it. Other methods of disposal discussed are aerobic, anaerobic, and mechanically aerated lagoons, as well as oxidation ditches, composting, and drying. Recommendations are made for the chemical treatment of animal wastes to reduce odors while spreading. (White-Iowa State)

## 0320-A4, A5, B1, D3, E1, E2, E3, F1, F2

### AGRICULTURAL WASTE IN AN URBAN ENVIRONMENT.

New Jersey Animal Waste Disposal Task Force.

Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' Atlantic City, New Jersey, Sept 14-17, 1970. New Jersey Animal Waste Disposal Task Force. 256 p.

Descriptors: *Farm wastes, *Water pollution control, *Environment, Waste disposal, Cities, Grants, Research and development, Legislation, Communication, Poultry, Cattle, Odor, Lagoons, Aeration, Nitrogen, Moisture content, Aeration, Costs, Sewage, Agriculture, *Waste water treatment, Waste treatment.
Identifiers: *Urban environment, Land-Grant Colleges, Funding, Public relations, Refeeding, Land disposal, Research needs, Biological systems, Waste handling, Research funds, Recycling.

The groundwork for the conference 'Agricultural Waste in an Urban Environment,' was laid several years ago when the New Jersey Animal Waste Disposal Task Force was formed. Since its formation the Task Force has moved in four directions in an effort to find a solution to the agricultural waste problem. These have consisted of studying current laws, making maximum use of available methods of disposal, utilization and odor control, encouraging research, and informing the public of the issues. The conference was based on these four approaches. Various resources available to deal with the problem were brought together and, consequently the attitude of people of all levels of the economy, both rural and urban, was determined; additional resources were discovered; new interests were created; better communications were established; the latest technology was reviewed; and a plan of action was developed. A resolution passed by the delegates calls for a national conference on this matter by appropriate Federal officials. The main purpose of the conference was to find a way for rural and urban communities to develop their economics and reach their full potentials without becoming a nuisance to each other. (White- Iowa State)

## 0321-A4, A6, C2, D1, D2, D3, F1

### WASTE DISPOSAL AND POLLUTION, POULTRY PROCESSING,

Ralston Purina Co., St. Louis, Mo. Engineering Waste Disposal Plant.
Rowland Retrum.
Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' New Jersey Animal Waste Disposal Task Force, p 64-75, Sept 14-17, 1970. 13 tab, 5 fig.

Descriptors: *Farm waste, *Poultry, Water pollution, *Waste water disposal, Sewage, Odor, Biochemical oxygen demand, Organic matter, Annual costs, Aeration, Aerobic treatment, Anaerobic digestion, Lagoons, Dissolved oxygen, Condensers, Incineration, Drying.
Identifiers: *Poultry processing, Solids, Rendering plants, Odor control, Chemical scrubbing, By-products.

It is the author's intention to attempt to define the problem of waste disposal and pollution with respect to poultry processing, to describe efforts now being made toward solution, to review cost effects, and to indicate promixing directions for accelerated investigation. The problems considered as the major pollution problems are feather litter, water pollution, sewage treatment odors, and rendering odors. Costs and other data are computed for an 80,000 bird per day broiler processing plant with a small associated rendering plant. Suggestions are made for decreasing the total waste load while increasing income. Systems for reducing the odor from both sewage treatment and rendering plants are explained. The odor problem is complex and there are no pat solutions. Any solution will be expensive. (White- Iowa State)

## 0322-A4, F1, F2, F6

### FUNDING FOR AGRICULTURAL WASTE RESEARCH,

Cornell Univ., Ithaca, N.Y.
N. C. Brady.
Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' New Jersey Animal Waste Disposal Task Force, p 89-98, Sept 14-17, 1970.

Descriptors: *Farm wastes, Research and development, Environment, Agriculture, Water pollution, Foods, Domestic wastes, Industrial wastes, Properties, Waste disposal, Grants, Population, Legislation, Education, *Costs.
Identifiers: *Research funds, Agricultural waste problem, Environmental quality, Intensive animal agriculture.

Three basic assumptions are made on which to establish a common ground. First the agricultural waste problem is serious. Secondly, agricultural waste problems are not extensions of those waste problems facing municipalities and industry. Thirdly, the solutions to the agricultural waste problem require knowledge that we do not now have. These assumptions lead to the fact that research and adequate funding are badly needed. The following are avenues that could be developed for solving agricultural waste problems in an urban environment: (1) Agriculture and its related industries must see environmental pollution as a major threat to themselves; (2) Agriculture should work closely with state and Federal legislators to obtain funding for direct application to State Experiment Stations and USDA research agencies; (3) Greater coordination between agencies is needed so that a larger proportion of the Federal Water Quality Administration's research funds can be used for animal waste studies; (4) We must not ignore the possibilities of reorienting research funds already available, and; (5) The training and education of professionals in agricultural waste management is needed. (White-Iowa State)

## 0323-A6, A11, B2, C1, D3, E2, F1, F6

### AGRICULTURAL WASTE RESEARCH NEEDS,

Cloisterdale Farms, Inc., Ephrata, Pennsylvania.
Glenn H. Herr.
Proceedings of the Conference, "Agricultural Waste in an Urban Environment," New Jersey Animal Waste Disposal Task Force, September 14-17, 1970, p. 109-117.

Descriptors: *Farm wastes, *poultry, *liquid wastes, *moisture content, volume, odor, ultimate disposal, toxicity, lagoons, sprinkler irrigation, pumping, annual costs, research and development,
Identifiers: *"Shud," community relations, liquid handling, hauling.

A poultry manure disposal method is explained which Cloisterdale Farms in Pennsylvania is presently converting to. With 360,000 hens and 35-40 tons of manure to dispose of daily, a liquid system consisting of lagoon, irrigation and hauling was soon found inadequate. One house was then converted to a semi-dry system in which "rakes" and airflow convert the 70-75% moisture raw waste into a 28-35% moisture product. Its advantages include easier handling, little or no odor, no restrictions on seasonal disposal, no great labor problem, and some as yet un-established value. Remodeling and operational costs are given. It is felt that a sizeable volume of funds is needed to support practical research in the waste disposal area. (White-Iowa State).

## 0324-A4, A5, A6, B3, C1, D1, D2, E2, E3, F3

### DISPOSAL OF SOLID AGRICULTURAL WASTES - CONCEPTS AND PRINCIPLES,

Cornell Univ., Ithaca, N.Y. Dept. of Civil and Agricultural Engineering.
Raymond C. Loehr.
Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' New Jersey Animal Waste Disposal Task Force, p 126-134, Sept 14-17, 1970. 12 ref.

Descriptors: *Farm wastes, *Research and development, Waste disposal, Drying, Dehydration, Incineration, Beneficial use, Environment, Water pollution, Temperature, Moisture content, Odor, Feeds.
Identifiers: *Research needs, *Land disposal, Composting, Refeeding, Pyrolysis, Utilization, Waste management.

The state of development regarding suitable disposal methods for agricultural solid wastes is in an embryonic stage. A variety of techniques are possible but little information exists on the broad applicability of the techniques or on the detailed design and use parameter for the techniques with these wastes. Because of technical or economic difficulties, composting, drying and dehydration, incineration, and pyrolysis have not found wide application for animal solid wastes. Refeeding and land disposal offer the greatest opportunities for satisfactory disposal of animal wastes in the near future. The important research needs in the area of animal waste disposal include: (1) more thorough investigation of promising techniques, (2) utilization of non-traditional concepts, (3) evaluation of feasible disposal methods as part of animal production operations, (4) more and detailed cost information, and (5) broad interdisciplinary approaches and studies. (White-Iowa State)

## 0325-A8, C2, E2

### RECYCLING AND UTILIZATION OF BIODEGRADABLE WASTES IN THE SOIL,

Rutgers-The State Univ., New Brunswick, N.J. Dept. of Agricultural Engineering.
Charles H. Reed.
Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' New Jersey Animal Waste Disposal Task Force, p 135-139, Sept 14-17, 1970. 2 fig.

Descriptors: *Farm wastes, *Biodegradation, Waste disposal, Water pollution, Nitrogen, Nitrogen compounds, Nitrogen cycle, Research and development, Conservation, Soil, Environment, Agriculture.
Identifiers: *Recycling, Utilization, Biological systems, Materials balance.

The survival of man depends upon the intelligent use of agriculture with its inumerable physical, chemical and biological systems and cycles. The author emphasizes that all biodegradable organic wastes could and should be recycled and utilized by natural biological systems on specialized sites or farms. The ability of soils to filter and degrade organic wastes and immobilize potential pollutants is widely recognized. Plants are among the best known converters of nitrogenous compounds to non-pollutional materials. A figure depicts the nitrogen cycle and how organic wastes are recycled by the soil. A chart is presented showing a program for recycling biodegradable wastes. To achieve this objective an interdisciplinary approach must be taken, which will necessitate much research requiring many tax dollars. (White-Iowa State)

## 0326-A4, A5, A6, C2, E2

### AGRICULTURAL WASTE RESEARCH NEEDS,

Rutgers-The State Univ., New Brunswick, N.J
Dept. of Agricultural Economics.
George W. Luke.

Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' New Jersey Animal Waste Disposal Task Force, p 140-141, Sept 14-17, 1970.

Descriptors: *Farm wastes, *Environment, Water pollution, Grants, Population, Surveys, Waste disposal, Volume, Odor, Livestock, New Jersey.
Identifiers: *Waste handling, Masking agents, Environmental quality, Residential areas.

Aided by a grant from the State Department of Health, the Department of Agricultural Economics conducted a survey of livestock enterprises in four agricultural counties in New Jersey to determine the volume of waste, the methods of handling waste, the cost of waste disposal, the attitude of farmers toward the problem of animal waste, and the location of farms relative to residential areas. The results of this survey are given and evaluated. Between 600,000 and 1 million tons of waste are produced and disposed of in the four counties annually. The typical method of disposal is on the land. Because the farms are small and confine only small numbers of animals, the threat to environmental quality is minimal. The closer to residential areas the more meticulous the farmers are in handling waste. Public agencies seeking to maintain environmental quality should consider educational programs emphasizing the most acceptable practices for the average size livestock farm.
(White-Iowa State)

### 0327-E3

**RECYCLED POULTRY NUTRIENTS,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
Howard C. Zindel.
Poultry Digest, Vol 30 (351), May 1971, p 231-233. 2 tab.

Descriptors: *Cycling nutrients, Farm wastes, Poultry, *Waste treatment, Waste disposal, Diets.
Identifiers: *Dried poultry waste, Recycled nutrients.

The text gives results of tests in which dehydrated poultry manure was incorporated into livestock feed. The feed was given to white leghorn chickens, beef cattle, sheep, dairy cattle, young calves, and goats. Tests on turkeys are just getting started. Three tests on chickens given control rations, 25% DPW (dehydrated poultry waste), and 12.5% DPW, gave the following results in production: 74.5%, 71.9%, 71.0% respectively. The conclusion is that the problem of smelly waste is eliminated, a valuable ingredient is gained which releases corn and corn protein for other world uses, the cost per dozen eggs or pound of gain is reduced, and an easy-to-handle fertilizer product (5-3-1), organic in nature and readily usable is obtained. (Hazen-Iowa State)

### 0328-A11, C3, F6

**EFFECTS OF CHLORTETRACYCLINE FEEDING ON BOVINE RUMEN MICROORGANISMS,**
Washington State Coll., Pullman. Dept. of Bacteriology.
R. E. Hungate, D. W. Fletcher, and I. A. Dyer.
Journal of Animal Science, Vol 14, 1955, p 997-1002. 1 fig, 3 tab, 7 ref.

Descriptors: *Ruminants, *Feeds, Laboratory tests, Fermentation, Inhibition, Methane bacteria, Microorganisms, Pollutant identification, Water pollution effects.
Identifiers: Manometric experiments, Chlortetracycline feeding.

Manometric experiments of short duration were employed to measure the total fermentation products of rumen contents from chlortetracycline-fed and control animals, both in the presence and absence of additional chlotetracycline. Inhibition by added antibiotic was greater in the control animals, indicating that calortetracycline feeding had altered the composition of the rumen microbial population. Methane production was diminished by the added chlortetracycline but this was probably a secondary result from inhibition in the production of the intermediates, hydrogen and formate. The potential for microbial activity in the rumen contents from chlortetracycline-fed steers was about the same as in the controls. The rumen micro-organisms appear to be somewhat more sensitive to chlortetracycline than to streptomycin. (Hazen-Iowa State)

### 0329-C2, D2, E3

**DISPOSAL OF HATCHERY WASTES,**
Harrold's Hatchery, Inc., Winterville, Ga.
Tom Harrold.
Poultry Digest, Vol. 30 (351), May 1971, p 250-251.

Descriptors: *Waste disposal, *Poultry, *Waste treatment, Incineration, Temperature, Disposal.
Identifiers: *Hatchery waste disposal.

A description is given in this text of a method of waste disposal which reduces waste to 5% of the original and produces a product desired by gardeners. This method is incineration. Five design criteria are given in considering incinerators for use in disposal of hatchery wastes. They are (1) burning area; (2) operating temperature; (3) temperature control; (4) refractory materials; (5) stack. Maintenance of an incinerator is minimal and the incinerator produces no odor and no smoke. The powdery ash, composed mainly of calcium and magnesium, produced is in demand by gardeners. (Hazen-Iowa State)

### 0330-B2, C2, D3, E2

**CONFINED SWINE MANURE DISPOSAL,**
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Robert A. Bella.
Master of Science Thesis, 1968. 157 p, 37 fig, 47 ref. OWRR Project A-011-KAN (2).

Descriptors: *Farm wastes, *Pigs, Aerobic conditions, Oxygen requirements, Waste water treatment, Biochemical oxygen demand, Chemical oxygen demand, Hydrogen ion concentration, Waste disposal.
Identifiers: *Swine wastes, *Oxidation ditch,*Rotor capacity.

The object was the evaluation of an oxidation ditch for the treatment of swine manure. The oxidation ditch was constructed as part of the foundation for each building. Slotted floors permitted the manure to discharge directly from the animal into the treatment unit. Data were collected at weekly intervals from September, 1966 to August, 1967. The data indicated that the oxidation ditch could treat swine manure without odor nuisances. These units were able to reduce the soluble BOD to less than 10 milligrams per liter with a total effluent BOD of about 1,200 milligrams per liter. The effluent also contained considerable salts in addition to the suspended solids. It was necessary that the treated effluent be discharged into cultivated fields rather than being discharged into the adjacent drainage ditch. A holding pond was used to store the discharge of the treated effluent prior to spreading on nearby fields. (Miner-Iowa State)

### 0331-A6, A7, A10, A12, B2, D3, E2

**DISPOSAL OF DAIRY MANURE,**
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering.
Curtis A. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol 8, 1965, p 110-112. 3 fig, 11 ref.

Descriptors: *Farm wastes, *Cattle, *Septic tank, Poultry, Fertilizers, Economics, Aesthetics, Efficiencies, Dusts, Evaluation, Value, Lagoons, Water pollution, Odor, Pumps, Methane, Anaerobic digestion, Aeration, Effluent, Recirculated water, Irrigation, Aerobic treatment, Waste water treatment.
Identifiers: *Scraper, *Dairy cattle, Manure production, Effectiveness, Push-button operation, Potential, Fly production, Appearance, Noise, Aerobic pond, Decomposition, Population equivalents, Agitation.

Heated septic tanks, adapted to recirculation of effluent, hold promise for efficient fluid handling of manure and other dairy wastes with minimum labor costs and reasonable structural costs. Effluent from a three chambered, heated septic is pumped to manure gutters behind specially designed stalls. The effluent provides enough pressure to force a scraper the length of the gutter, thus pushing the accumulated manure to the septic tank. General design criteria are given. An evaluation scale is developed for qualitative evaluation of various manure handling systems. (White-Iowa State)

### 0332-A6, A10, B2, B4, C1, C2, E2, F1

**HOW WE HANDLE LIQUID MANURE,**
Hoard's Dairyman, Vol 109, November 25, 1965, p 1254-1255, 1280-1281. 14 fig, 1 tab.

Descriptors: *Farm waste, *Cattle, *Storage tanks, Slurry, Costs, Volume, Age, Construction, Moisture content, Odor, Pumps, Electric power, Impellers, Nutrients, Waste water treatment.
Identifiers: *Dairy cattle, *Liquid manure system, Free stall housing, Agitation, Tank spreader, Fly breeding.

Five top dairymen are interviewed about their liquid manure handling systems. All incorporated storage tanks, and disposal on land with tank spreaders. Different types of agitation and pumping methods are explained. The systems ranged in cost from $3250 to $7800, or from $35 to $52 per cow. This included storage tank, agitation and pumping equipment, and tank spreaders. Several spent up to $6600 for concreting the barnyards. The tanks varied in capacity from 18,000 to 75,000 gallons, and were emptied as often as once a week to once every two months. The need for added moisture is discussed as well as fly and odor problems. Some disadvantages are given, the major one being the high capital investment. (White-Iowa State)

### 0333-A10, B3, C1, C3, D3

**AEROBIC DIGESTION (COMPOSTING) OF POULTRY MANURE,**
A. Livshutz.
World's Poultry Science Journal, Vol 20, 1964, p 212-215. 1 fig.

Descriptors: *Farm wastes, *Poultry, *Aerobic treatment, Aeration, Plastics, Plastic pipes, Width, Depth, Length, Volume, Pressure, Moisture, Temperature, Aerobic bacteria, Oxygen, Odor, Hydrogen ion concentration, Moisture content, Compaction, Waste water treatment.
Identifiers: *Composting, *Windrow method, Plastic sheets, Pressure blower, Forced-air system, Decomposition, Fly breeding, Carbon-nitrogen ratio, Oxidizing atmosphere.

The article describes a windrow method of composting in which a pressure blower forces air through lateral 3/4 inch diameter pipes. The pipes have four rows of about 15 holes, each one to two mm. diameter. The windrow, up to 50 meters long and 3 meters wide, is covered with a plastic sheet. Nine advantages of the aeration system are given. The plastic covering may eliminate turning of windrows, by preventing the upper layers of the composting material from drying out. The carbon-nitrogen ratio should be around 25-30:1 with a pH of about 7. Optimum moisture should be about 50 per cent. After about two weeks of composting, depending on the material and climatic conditions, the manure is sterilized, odorless and dry and can be used profitably for agricultural purposes. (White-Iowa State)

### 0334-A6, B2, C1, C2, C3, D3

**CHEMICAL AND BIOLOGICAL REACTIONS FROM LAGOONS USED FOR CATTLE,**
Wisconsin Univ., Madison.
S. A. Witzel, Elizabeth McCoy, and Richard Lehner.
ASAE Paper No 64-417. Transactions of the American Society of Agricultural Engineers, Vol 8, p 449-451, 1965. 1 fig, 16 ref.

Descriptors: *Oxidation lagoons, *Biochemical oxygen demand, *Anaerobics, Algae, Bacteria, Water pollution sources, Odor, Farm waste, Sludge, Solid wastes, Decomposting organic matter, Lagoons, Cattle.
Identifiers: Organic nitrogen, Bacteriological study, Aerobicity.

An experimental lagoon to receive the wastes as liquid manure from six bulls was constructed. In an experimental barn the manure from the bulls was washed daily into two gutters 24 in. wide at the top. The gutters had a capacity of 2000 gallons. The gutters were flushed every seven days into a lagoon. The circular lagoon had a 60 ft diameter at the top, a 40 ft diameter at the bottom and was 5 ft deep. Liquid manure samples were taken from the barn gutter and from the lagoon manure liquid and sludge. BOD tests were conducted on all samples and the percent BOD reduction from gutter to lagoon was calculated. Other tests were made to determine percent total solids removal, organic nitrogen content, pH values, and temperature. Extensive tests were made and reported on bacteria content, both quantitative and qualitative. Five conclusions of the study are mentioned. (Parker-Iowa State)

### 0335-A6, B2, B4, E2

**EQUIPMENT FOR DISPOSAL OF AGRICULTURAL EFFLUENTS,**
National Agricultural Advisory Service, London (England).
C. Culpin.
Chemistry and Industry, p 350-353, February 29, 1964. 3 ref.

Descriptors: *Farm wastes, *Disposal, Effluents, Slurries, Storage tanks, Silage, Distribution, Methane, Mixing, Distribution systems, Sprinkler irrigation, Pumps, Labor, Odor, Waste disposal, Waste water treatment.
Identifiers: Agitation, Vacuum pumping, Tanker.

Types and quantities of manure and other effluents are described, as well as systems and equipment for their disposal in Britain. Different storage methods and means of agitation or mixing are described. Four distribution systems are discussed. These include either some type of sprinkler irrigation or a tank wagon method. Labor requirements for both distribution methods, as well as future prospects are given. (White-Iowa State)

### 0336-A7, A11, B2, C2, C3 E2

**DISPOSAL OF FARM EFFLUENT,**
Ministry of Agriculture, Fisheries and Food, Norwich (England). Veterinary Investigation Center.
E. A. Gibson.
Agriculture, Vol 74, 1967, p 183-188.

Descriptors: *Slurries, *Farm wastes, *Salmonella, Cattle, Hogs, Infection, Incubation, Diseases, Gases, Hydrogen sulfide, Ammonia, Carriers, Waste water treatment, Waste disposal.
Identifiers: *Disease hazard, Anthrax, England, Johnes disease, Avian tuberculosis, Salmonella dublin, Salmonella typhimurium.

The possibility of spreading infection by the use of slurry manure disposal techniques is discussed. It is well known that many infections of farm live-stock are spread in their excreta. Little is known about the effects of such spread as slurry on the land, but under certain circumstances, the use of these systems could increase the disease hazard. Salmonella infection and Johnes disease are discussed in this respect, and anthrax and avian tuberculosis are mentioned more briefly. It is suggested that effluents thought to contain salmonella should not be put on the pasture or fodder crops that will be used for cattle or sheep within six months. The same precaution applies to Johnes disease, except that for cattle up to six months old, the period should be extended to twelve months. These figures may need to be revised as further knowledge and experience is gained. The non-infectious hazards to animal health include the liberation of toxic gases when slurry is agitated or emptied. (White-Iowa State)

### 0337-A6, B4, C1, C2, E1

**A REVIEW OF POULTRY WASTE DISPOSAL POSSIBILITIES,**
Ministry of Agriculture, Fisheries and Food, London (England).
C. T. Riley.
Water Pollution Control, Vol 67, No 6, p 627-631, 1968. 5 tab, 4 ref.

Descriptors: *Waste disposal, *Waste treatment, *Biochemical oxygen demand, *Costs, Waste identification, Drying, Land use, Aeration, Loading, Odor.
Identifiers: *Poultry waste disposal, *Bod/food intake relation, *Waste storage, *Chemical and physical properties (Waste), Heat drying, Nitrogen, Phosphorus, Potassium, Pasveer ditch, Bubble-gun installation, Processing stations (Poultry), Deep litter and broiler houses, Inedible by-products, Shock load.

Waste disposal problems in the poultry industry, contemporary poultry practice and related developments in agriculture are discussed, and trends considered. The main types of waste are analyzed; wastes from laying hens has higher NPK values than any other agricultural waste. A National Agricultural Advisory service (NAAS) survey emphasized the lack of knowledge, high cost of waste disposal to egg producers and social effects of the current tendency to increase livestock numbers and (due to transportation costs) to group production units near centers of consumption. Analysis is made of waste quantities and the chemical and physical properties of the waste. A reliable correlation appears to exist in BOD/food intake relationship. Settling difficulties in treatment are noted. The relationships between disposal practices and land uses are examined. The major problems arising from traditional methods of disposal are analyzed, especially the storage and heat drying phases. Traditional methods of sewage treatment no longer appear suitable for poultry wastes. The 'Pasveer ditch' or 'bubble-gun' type of installation may be more suitable; however, the high concentration of waste remains a problem. The treatment and disposal of wastes from deep litter and broiler houses is troublesome mainly if local accumulations become too large. This type of waste has the highest nitrogen content of all agricultural wastes. (D'Arezzo-Texas)

### 0338-A6, C2, D3

**DIGESTION TESTS OF LIVESTOCK WASTES,**
California Univ., Davis. Dept. of Agricultural Engineering.
Samuel A. Hart.
Journal of the Water Pollution Control Federation, Vol 35, No 6, June 1963, p 748-757. 7 fig, 2 tab, 11 ref

Descriptors: *Farm wastes, *Poultry, *Cattle, *Sludge digestion, Stabilization, Hydrogen ion concentration, Alalinity, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Carbon, Organic matter, Sewage, Odor, Gases, Waste water treatment.
Identifiers: *Dairy cattle, Volatile acids, Digesters, Gas production.

A laboratory test on the digestion of chicken and dairy manures indicates the following: (1) Both chicken and dairy manure would be stabilized satisfactorily in high-rate digesters equipped with adequate sludge-mixing equipment. (2) Dairy manure, because of its high lignin content, will effect organic matter destruction of only 10-15 percent. (3) The destruction of volatile matter expected from digesting chicken manure closely approximates that of municipal sludge digestion. (4) Operational parameters of pH, alkalinity, volatile acids, and the effect of temperature follow those expected for municipal sludge digestion. (5) Although nitrogen levels of chicken manure are high, digestion does not cause loss of nitrogen, but rather, through destruction of organic matter, it is concentrated to 8 or 9 per cent in the digested sludge. (6) BOD and COD are best expressed in terms of O2/mg VS for the high solids content of manures and manure sludges. (7) COD on a mg O2/mg VS basis increases upon digestion since digestion is a reducing reaction. (8) In total, digestion appears to have merit for stabilizing chicken manure. Consideration would still have to be given to final disposition since digestion does not destroy the waste. (White-Iowa State)

### 0339-A6, A11, B2, D3, E3

**FLUSHING AWAY MANURE PROBLEMS,**
Hog Farm Management, Minneapolis, Minn.
Cliff Johnson.
Hog Farm Management, Vol 8, No 1, p 23-25 and 68, January 1971. 7 fig.

Descriptors: *Recirculated water, *Disposal, Farm wastes, Reclaimed water, Lagoons, Hogs, Odor, Labor, Waste water treatment.
Identifiers: *Flushing gutters, Oxidation ditches, Siphon mechanism, Swine, Collection, Automatic dosing siphon.

The flushing gutter system being experimented with at Iowa State University is described. Two variations of the flushing technique, one utilizing a solenoid flushing mechanism and the other a siphon mechanism, have been studied. In the first case, water fills an overhead tank which trips the solenoid causing a plug to lift and thus discharging the tank's contents. For the siphon system, a tank is fitted with 2 1/2 in. N-shaped trap pipe underneath.. As the tank fills with water, enough water pressure is built up to force the tank's contents down the pipe into the gutter. The water is discharged rapidly (150 gal. in 62 sec.) through the 2 1/2 in. pipe. Because of the water's force as it is flushed, no dung is left in the gutter after flushing. The gutter is flushed three times per day. Advantages of the system include (1) reduced ventilation requirements, (2) less odor, (3) better feed efficiency, (4) no gas problem, and (5) no labor involved in manure removal. (Christenbury-Iowa State)

### 0340-A8, C2, E2, F1

**FERTILIZATION OF ANNUAL RANGELAND WITH CHICKEN MANURE,**
California Univ., Riverside. Dept. of Agronomy.
Cyrus M. McKell, Victor W. Brown, Robert H. Adolph, and Cameron Duncan.
Journal of Range Management, Vol 23, p 336-340, 1970. 2 fig, 6 tab, 4 ref.

Descriptors: *Poultry, *Grasslands, *Farm wastes, Fertilizers; Costs, Range management, Cost-benefit analysis, Crop response, Phosphorus, California, Proteins, Waste water treatment.

Identifiers: *Chicken manure, Palatability, Rangeland fertilizer.

Where annual rangelands are close to the source of supply, fertilization with chicken manure appears to hold considerable promise in improving the production of forage for grazing. Fertilized polts were ready to be used earlier in forage of a higher quality and palatability. Protein and phosphorus were significantly higher in forage from fertilized plots. Fertilizer value of chicken manure is equal to equivalent rates of commercial fertilizer. There appears to be a slower release of fertilizer elements from chicken manure than from inorganic fertilizer. Annual forage legumes do not appear to benefit initially from the application of chicken manure. In subsequent years following fertilization, the legumes appear to thrive on the increased level of available phosphorus. It was profitable for rangeland operators to fertilize with poultry manure provided they could get it for $3.10 to $4.35 per ton applied. An average of 1,600 pounds of extra feed was obtained for each ton of manure. (Christenbury-Iowa State)

### 0341-A4, B2, D3

**AGRICULTURE AND THE PREVENTION OF RIVER POLLUTION, AS EXPERIENCED IN THE WEST OF SCOTLAND,**
Clyde River Purification Board (Scotland).
F. J. Little.
Journal Proceedings of the Institute of Sewage Purification, 1966, p 452-454. 1 tab, 7 ref.

Descriptors: *Farm wastes, *Water pollution sources, Effluents, Cattle, Poultry, Hogs, Sheep, Rivers, Silage, Biological treatment, Waste water treatment.
Identifiers: *Scotland, Dairy cattle, Silage liquor, Sheep dips, Remedial action,, Extended aeration, Rivers (Scotland) Act 1951.

Different types of polluting effluents in Scotland are discussed, and what action has been taken to prevent river pollution. Agricultural effluents can be divided into three groups - animal, vegetable, and chemical, of which animal effluents pose the greatest problem. Dairy waste is the most prevalent effluent, while beef, sheep, hogs and poultry play a minor role. Biological treatment here is in the experimental stage. Silage liquor has presented a problem due to its high BOD. Chemical effluents result from the use of sheep dips, herbicides, fertilizers, bactericides, and dairy detergents. Problems arise from careless use of equipment rather than intentional discharges. The problems of disposal are complex and require the patience and understanding of both farmer and the general public. A discussion follows the paper. (White-Iowa State)

### 0342-A11, C2, D2, D3, E3, F6

**IN VITRO DIGESTIBILITY OF CHEMICALLY-TREATED FECES,**
Department of Agriculture, Beltsville, Md. Animal Science Research Div.
L. W. Smith, H. K. Goering, and C. H. Gordon.
Journal of Animal Science, Vol 31, No 6, p 1205-1209, December 1970. 4 tab, 16 ref.

Descriptors: *Digestion, *Chemical degradation, Farm wastes, Ruminants, Fermentation, Cellulose, Costs, Alkalis, Waste treatment.
Identifiers: *Chemically-treated feces, Cell wall, Microbial responses, Oxidants.

Chemical treatment is a means for enhancing the digestibility of the indigestible plant cell wall residues in ruminant feces. Enhanced digestibility was ascertained with detergent solubility methods and in vitro rumen fermentation were obtained through dried chemical degradation of meicellulose, cellulose, and lignin and also through increasing the accessibility of the remaining cell wall for ruminal microbial fermentation. Chemical treatment of indigestible alfalfa or sudax fecal cell walls resulted in greater than 90% digestion (chemical degradation and microbial digestion). This experiment was designed to point out some of the conditions required for maximum chemical hydrolysis and maximum cell wall utilization. Whether or not these conditions can be approximated in feeding trials remains to be demonstrated. (Christenbury-Iowa State)

### 0343-A11

**BOVINE SALMONELLOSIS (S. TYHIMURIUM) IN A FEEDLOT OPERATION,**
W. C. Oglesby.
Veterinary Medicine/Small Animal Clinician, Vol 59, p 172-174, February 1964. 4 ref.

Descriptors: *Salmonella, *Cattle, Antibiotics, Temperature, Animal diseases, Stagnant water, Mud, Waste treatment, Diseases, Public health, Water pollution effects.
Identifiers: *Feedlot, Diarrhea, Salmonella typhimurium, Necropsy, Medication, Nitrofurazone.

An epizootic of a severe respiratory-enteric syndrome appeared in a feedlot operation of 1,000 head of cattle. Salmonella typhimurium was isolated from the organs of 5 carcasses, 3 fecal specimens, and from mud in a waterhole from which the animals drank. Correction of hygienic conditions, electrolyte supplementation, sulfathiazole medication in the drinking water, and intravenous antibiotics gave only mediocre response. Individual dosing with a nitrofurazone preparation and addition of nitrofurazone to drinking water was successful in eradicating the disease. (White-Iowa State)

### 0344-A4, A5, B2, B3, D3, F1

**THE COLLECTION OF MANURE FROM HOUSED LIVESTOCK,**
West of Scotland Agricultural Coll., Glasgow (Scotland). Dept. of Farm Buildings.
R. J. Forsyth.
Journal and Proceedings of the Institution of Agricultural Engineers, Vol 21, p 129-133, 1965.

Descriptors: *Farm wastes, *Cattle, Water pollution control, Sludge, Storage capacity, Storage tanks, Waste dilution, Construction materials, Costs, Slurries, Sluice gates, Electric power costs, Rotors, Waste water treatment.
Identifiers: *Dairy cattle, *Oxidation ditch, Slatted floors.

The paper describes collection and handling methods for dairy manure in Scotland. Parlor systems are scarce because of their large bedding requirement. Slatted floors in conjunction with free housing systems has proven highly satisfactory. Different slat types are discussed and evaluated. Under slat tanks or channels are described as well as criteria for dilution, storage capacity, and sluice gates. The possibility of using the Pasveer oxidation ditch is introduced as a result of stringent pollution regulation. Design and costs for the oxidation ditch are presented. A discussion follows the paper. (White-Iowa State)

### 0345-A4, A11, A12, C3

**BOVINE SALMONELLOSIS ASSOCIATED WITH CONTAMINATED CREEK WATER AND HUMAN INFECTION,**
Kansas State Univ., Manhatton. Coll. of Veterinary Medicine.
C. M. Hibbs, and V. D. Foltz.
Veterinary Medicine/Small Animal Clinician, Vol 59, p 1153-1155, November 1964. 6 ref.

Descriptors: *Sewage, *Salmonella, Cattle, Sewage bacteria, Water pollution effects, Streams, Infection, Public health, Diseases, Waste treatment.
Identifiers: Human infection, Nicropsy, Diarrhea, Salmonella typhimurium, Bacteriologic examination, Water samples.

A case of Salmonelliosis in calves, which may have been associated with human infection, is discussed. Salmonella typhimurium was isolated from two calves, creek water and one human. Though the origin of the infection was not specifically determined, the findings indicated that untreated house sewage may have been the source. The seriousness of water pollution and some of its ramifications are evident. An education program on water pollution is recommended. (White-Iowa State)

### 0346-A6, A10, B2, C1, C2, D3

**LAGOONS FOR LIVESTOCK MANURE,**
California Univ., Davis.
Samuel A. Hart, and Marvin E. Turner.
Journal Water Pollution Control Federation, Vol 37, No 11, November 1965, p 1578-1596. 5 tab, 6 fig, 9 ref.

Descriptors: *Farm wastes, *Poultry, *Cattle, *Hogs, *Lagoons, Stabilization, Biochemical oxygen demand, Anaerobic conditions, Sewage, Aerobic conditions, Odors, Volume, Sludge, Nitrogen, Phosphorus, Potassium, Chemical oxygen demand, Ammonia, Physical characteristics, Chemical characteristics, Hydrogen ion concentration, Alkalinity, Scum, Color, Opacity, Earth-water interfaces, Infiltration, Anaerobic digestion, Waste water treatment.
Identifiers: *Loading rates, *Physical appearance, Surface area, Total solids, Volatile solids, Volatile acids, Fly activity, Crusting, Pilot lagoons, Materials balance, BOD reduction, Sludge seed.

The need for more closely controlled tests of a laboratory type concerning livestock manure lagoons prompted this study. Eight concrete ringed pilot lagoons four feet in diameter and seven feet were used in the experiment. The units were fed poultry, dairy and cattle manure during the two year test. Chemical and physical properties were monitored weekly and are presented in tabular form. Infiltration from the packed earth bottom was considerable. This hampered the accurate determinations needed for a materials balance. Appearance, odors, and fly activity were noted. A section tells how to use the knowledge gained from the experiment. It is felt that with proper construction, property loading rates, and proper operation, lagoons can be expected to be satisfactory. (White-Iowa State)

### 0347-B2, C2, D3, F1, F6

**AEROBIC PURIFICATION OF FARM WASTE,**
Rijkszuivel Agrarische Afvalwater Dienst, Arnhem (Netherlands).
H. M. J. Scheltinga.
Journal Proceedings of the Institution of Sewage Purification, p 585-588, 1966. 1 fig, 4 tab, 11 ref.

Descriptors: *Farm wastes, *Hogs, *Biological treatment, Anaerobic digestion, Activated sludge, Rotors, Nitrogen, Biochemical oxygen demand, Chemical oxygen demand, Foaming, Nitrification, Costs, Effluent, Laboratory tests, Ammonia, Waste water treatment.
Identifiers: *Oxidation ditch, Loading rates, Retention time.

Model tests, laboratory investigations, and finally a full scale field experiment with oxidation ditches were carried out in Holland, where an effective and economical waste treatment system is being sought. A 50 per cent BOD reduction was obtained using anaerobic decomposition in the laboratory. Initial and final characteristics of the pig waste are given before and after treatment in the oxidation ditch. Foaming was excessive from the start. Nitrification played an important part in eliminating the ammonia. Total and expected operational costs are given. (White-Iowa State)

### 0348-A9,A10,B1,D2,D3

**BIOLOGICAL FLY CONTROL IN DEEP PITS,**

Poultry Digest, p. 25, January 1971.

Descriptors: *Poultry, *biological treatment, farm wastes, disposal.
Identifiers: *Fly control, fly breeding, deep pit.

Though fly control is one of the reasons for building deep pit poultry houses, some operators have had serious fly problems when houses were put into operation. Later, if the manure is not too wet, parasites and predators that are natural enemies of flies become established. "Flies were noticeably less of a problem in many deep pit cage houses this past year," observed 'Maine's Timely Topics' for November, 1970. "Flies have been controlled with sprays and/or baits. However, many deep pit cage house owners got by last summer with little or no spraying. In all cases, the houses were two, three or more years old." When it becomes necessary to remove manure, a partial cleanout is preferable. Leave behind some of the fly's natural enemies. (Christenbury-Iowa State).

### 0349-A4, A5, A8, A11, A12, B3, D1, D3, E2

**MAXI-MIXING FOR MANURE DISPOSAL,**

Poultry Digest, p. 12, January 1971.

Descriptors: *Disposal, farm wastes, poultry, pollution.
Idenitifiers: *Composting, Maxi-mixing.

When a Connecticut poultryman was confronted with a large quantity of manure and small acreage, he mixed soil into the manure with a bulldozer. The result was a composted mixture in a few months, according the Connecticut in a few months, according to the Connecticut Poultry Notes. Maxi-mixing is the term used to describe this disposal system using a maximum amount of soil. Monitoring and further research are being conducted to establish limits before pollution and plant toxicity occur. Heavy application of animal manure to land can cause nitrate and nitrite levels in water high enough to be hazardous to humans and ruminants. (Christenbury-Iowa State)

### 0350-A6, A10, B1

**SCHEDULE MANURE REMOVAL TO AVOID FLY BREEDING,**

'California University, Riverside.
Robert H. Adolph.
Poultry Digest, p. 29, January 1971.

Descriptors: *Farm wastes, *poultry, California, anaerobic conditions, odors.
Identifiers: *Fly breeding.

Because January to June in California is the peak period for fly breeding, Dr. Andrew Deal, University of California, Riverside, advises against removal of manure from poultry houses during that time, You are much better protected from fly breeding buildup if the manure can be kept dry. Wet manure is conducive to fly breeding and the generation of putrid odors. (Christenbury-Iowa State).

### 0351-B2, F1

**DAIRY SET-UP FOR 200 COWS,**

Guy Faulkner.
Power Farming, p 38-39, Jan 1970. 6 fig.

Descriptors: *Farm wastes, Lagoons, Slurries, Cattle, Hogs, Silage, Cereal crops, Costs, Waste water treatment, *Oxidation lagoons.
Identifiers: *Dairy cattle, *Evaporative lagoon, Free stall housing, Milking parlor, Farrowing houses, Collecting yard.

The article describes the layout and features of a newly developed dairy operation for 200 cows. Features include three 120 feet long steel framed loafing barns and a 100,000 cu. ft. capacity evaporative lagoon. The solidified contents of the lagoon will be dug out by a contractor in summer. A 200 sow pig unit has also been established on this 500 acre Sussex farm. (White-Iowa State)

### 0352-A2, A4, A8, B2, E2

**DISPOSAL OF WASTES FROM SWINE FEEDING FLOORS TO MINIMIZE STREAM POLLUTION,**

Maryland Univ., College Park. Dept. of Agricultural Engineering.
W. [illegible]. Schwiesow, H. L. Brodie, and H. J. Eby.
Completion Report, University of Maryland, Water Resources Research Center, January 1970. 11 p. OWRR Project A-004-MD (1).

Descriptors: *Farm wastes, *Water pollution sources, *Pigs, *Septic tanks, Digestion tanks, Sedimentation tanks, Soil disposal fields, *Waste disposal, Waste water treatment.
Identifiers: *Flushing gutters, Swine manure.

This research was to investigate the feasibility of a septic disposal system with an underground distribution system as a means of eliminating runoff from swine feeding floors into the surface waters. Installation provided for hydraulic cleaning of the feeding floor. Manure, water and uneaten feed was washed into gutters, one on each side of the house. Modifications included the addition of a 7,000 gallon tank, a 1,200 gallon tank and connecting 4 inch PVC pipe. Six hundred feet of perforated plastic drain lines were located near the tanks. It was soon evident that the large tank intended to serve as a septic tank was inadequate and performed primarily as a sedimentation tank. Data taken showed this tank was satisfactory for accumulating solid wastes for a period of about 5 weeks. Solids were removed by mechanical means. Tests on the tile distribution system showed that the capacity to dispose of the liquid effluent was more than needed. Proper operation should provide a satisfactory means of disposing of the liquid portion of the wastes without polluting the nearby river. (Miner-Iowa State)

### 0353-A6, B2, C2, D3, E2

**OXIDATION DITCH TREATMENT OF SWINE WASTES, SUMMARY REPORT,**

Illinois Univ., Urbana.
D. L. Day, D. D. Jones, J. C. Converse, A. H. Jensen, and E. L. Hansen.
American Society of Agricultural Engineers, Paper No. 69-924. 16 p, 1 tab, 9 fig, 24 ref. Bureau of Solid Waste Management Research Grant No. EC-00245-03, also Reg Res Proj NC-69.

Descriptors: *Farm wastes, *Waste water treatment, Hogs, Slurries, Odors, Livestock, Effluents, Mechanical equipment, Protozoae, Biochemical oxygen demand, Chemical oxygen demand, Farm lagoons, Sludge, Aerobic treatment, Biological treatment, Liquid wastes, Laboratory tests, Design criteria, *Oxidation lagoons.
Identifiers: Oxidation ditches, Pasveer oxidation ditch, Slotted floor, Livestock buildings, Ciliated protozoan, Swine, Oxygenation capacity, Loading rates, Field tests.

Swine wastes research for the three-year period beginning September 1, 1966 is summarized. Upon finding that swine manure could be aerobically treated, a modification of the Pasveer oxidation ditch was tested. The in-the-building oxidation ditch has proven itself in the field as capable not only of eliminating objectionable odors from manure pits but of reducing the BOD5 pollutional value of the waste by about 90 percent. The volatile solids can also be reduced by about 50 percent. Even so, the mixed liquor should not be discharged directly into a stream. There will, however, be surplus water and sludge to be disposed of, as with any other waste-treatment system. Operating the ditch with a constant liquid depth and a constant rotor immersion depth is recommended for operator convenience. This can be done by using an overflow. Having the mixed liquor overflow into an aerobic lagoon is also in keeping with operator convenience and low labor requirements. The lagoon can have a fluctuating depth, so that surplus water and sludge can be removed at a convenient time. The simplest method is by using irrigating equipment. (Christenbury-Iowa State)

### 0354-A11, A12, C3

**SALMONELLOSIS IN CATTLE,**

Ministry of Agriculture, Fisheries and Food, Norwich (England). Veterinary Investigation Center.
E. A. Gibson.
Agriculture, Vol 73, 1966, p 213-216.

Descriptors: *Farm wastes, *Cattle, *Salmonella, Pathogenic bacteria, Infection, Bacteria, Carriers, Disinfection, Water treatment.
Identifiers: *Salmonella dublin, *Salmonella tyhimurium, Calves, Illness, England, Clinical signs, Vaccine, Prevention, Outbreaks.

The article describes the diagnosis, treatment, clinical signs, and prevention of salmonella in cattle. Though usually a disease causing calf losses it can affect adult cattle too. Under British conditions two main organisms are responsible. These are S. dublin which is essentially a pathogen of cattle, and S. typhimurium which seems able to infect all species of birds, animals, and man with equal facility. Recommendations are made for the disinfection and prevention of the disease. (White-Iowa State)

### 0355-A4, B2, C2, D3, F1

**FARM WASTES,**

Netherlands Government Agricultural Waste Water Inst., Arnhem.
H. M. J. Scheltinga.
Water Pollution Control, Vol 68, No 4, p 403-413, July-August, 1969. 3 fig, 2 tab, 5 ref.

Descriptors: *Farm wastes, *Activated sludge, *Aerobic treatment, Water pollution, Extended aeration, Fertilizers, Biochemical oxygen demand.
Identifiers: *Oxidation ditch.

Manure in modern automated animal houses is often collected by falling through slatted floors into a channel. The final waste is a slurry and has little value. Volume, dry matter, BOD, and total N values are listed for man, cow, calf, sheep, pig, and hen wastes. Anaerobic manure storage results in 50% BOD reduction. The usual disposal method is using a fertilizer, but there must be a demand within a reasonable distance. Volume reduction methods are: treat the slurry liquid portion separately; or dewater the slurry mechanically or thermally. Treatment by oxidation ditch is discussed. Average effluent figures, in mg/l, are: COD, 100-1000; BOD, 10-100; NH3, 5-50; NO2, 0-50; NO3, 10-200; pH, 6.5-8.5. Oxygen concentration is important; and OC: load ratio of 2 is suggested for design. There was a 40-50% NH3 and total N reduction when air was bubbled thru a pig waste, but no reduction occurred in a similar waste which has been poisoned with C (++). It was concluded that mechanical ammonia stripping does not eliminate nitrogen compounds. Oxidation ditch construction is discussed. Costs of alternative disposal methods such as transportation to farm land or artificial drying must be considered when deciding which to use on oxidation ditch. (Steiner-Texas)

### 0356-A8, E2

**FURROW MANURE DISPOSAL,**

Rutgers University, Agricultural Engineering Department.
Charles H. Reed.
Poultry Digest, Vol. 24, 1965, p. 278, 1 fig.

Descriptors: *Farm wastes, *poultry, furrows, rates of application, disposal, chutes.

Identifiers: *Tank trailer, capacity, plow, solids content, plow furrow cover, auger agitator.

The author reports on a research project to explore the feasibility of disposing of poultry manure in plowed furrows. A 750 gallon tank trailer was equipped with an auger agitator operated by an engine, and a center rear spreader and chute. The chute was changed to the front so the operator could see and control the amount of poultry manure, at 22% solids, deposited in the bottom of a furrow. Further refinement resulted in pulling the trailer behind a single bottom mounted plow. This achieved the objective of depositing the manure in a previously plowed furrow - covering the manure and opening the next furrow in one operation. At present a scheme is being devised to mount the plow on the tank trailer. (White-Iowa State).

### 0357-B1, F1

**MECHANICAL CLEANING OF COWSHEDS,**
Agricultural Land Service, Leeds (England).
J. N. Addison.
Agriculture, Vol 77, No 11, November 1970, p 534-536.

Descriptors: *Farm wastes, Cattle, On-site data collection, Age, Costs, Specifications, Depth, Width, Length, Slopes, Ponding, Maintenance, Waste water treatment.
Identifiers: *Dairy cattle, *Mechanical cleaners, *England, Continuous type, Shuttle type, Cow sheds, Blades.

Twenty-one cowsheds on eighteen farms were surveyed to establish the extent to which mechanical channel cleaners had been installed, their age, condition, costs, and reasons for their installation in the first place. Problems with the mechanical cleaners are discussed as well as design specifications. The cost per cow of the shuttle type cleaner was found to be about 21 pounds and that of the continuous type 18 pounds. (White-Iowa State)

### 0358-A2, A4, B2, C1, C2, D2, D3, E2

**TREATMENT OF FARM EFFLUENTS,**
Water Pollution Research Lab., Stevenage (England).
A. B. Wheatland, and B. J. Borne.
Chemistry and Industry, February 29, 1964, p 357-362. 5 tab, 7 ref.

Descriptors: *Farm wastes, *Cattle, *Hogs, *Waste water treatment, Surface runoff, Volume, Water pollution, Biochemical oxygen demand, Cooling water, Carbon, Nitrogen, Nitrate, Effluents, Sewage, Filtration, Irrigation, Farm ponds, Silage, Organic matter, Biological treatment, Septic tanks.
Identifiers: *England, *Dairy cattle, Pollutional strength, Milking parlors, Permanganate, Recirculation, Land disposal, Soakaways, Chemical treatment.

Sources, volumes, and strength characteristics of farm effluents are discussed. A major portion deals with dairy and waste water effluents, coming from milking parlors and holding pens. Chemical and physical properties are listed in tabular form. Hog wastes and silage liquor are mentioned briefly as effluent sources. Treatment methods discussed include disposal on land, discharge to a sewer, biological treatment, septic tanks and chemical treatment. Disposal on land may be accomplished by use of tankers, soakaways, or irrigation. The use of storage ponds facilitates the latter. (White-Iowa State)

### 0359-A6, B2, C2, C3, D3, F1

**WHIPPING THE MANURE PROBLEM,**
Alan Linn.
Farm Quarterly, Winter 1966-1967, p 56-59, 115-116. 4 fig, 2 tab.

Descriptors: *Farm wastes, *Hogs, *Oxidation, *Aerobic bacteria, Labor, Odor, Fertilizer, Value, Organic matter, Carbon dioxide, Water, Nitrogen, Ammonia, Nitrites, Nitrates, Phosphorus, Potassium, Hydrogen sulfide, Methane, Anaerobic bacteria, Aeration, Design standards, Volume, depth, Foaming, Dispersion, Costs, Submergence, Biochemical oxygen demand, Oxygen, Temperature, Waste water treatment.
Identifiers: *Oxidation ditch, *Paddle wheels, Agitation, Circulation, Batch system, Continuous system, Paddle wheel diameter, Slatted floors.

The oxidation ditch is described as an important new breakthrough in manure handling. Advantages of the oxidation ditch include savings in labor, handling manure as a liquid, elemination of almost all odor, and the preservation and concentration of fertilizer nutrients. Basic design standards are given for the ditch and paddle wheel. If the ditch is managed on a continuous basis, 1 1/2 percent of the ditch volume can be added as manure daily. General management requirements and costs are included. The paddle wheel with a 1 1/2 to 3-hp motor costs about $600. The ditch walls can be incorporated into the building's foundation. Estimated power costs are about $1.00 per hog and $8.20 per 1000 pound dairy cow per year. Many changes in confined livestock production through use of the oxidation ditch are contemplated. (White-Iowa State)

### 0360-B2, C1, C2, C3, D3

**THE BACTERIAL POPULATION OF AN INDOOR POULTRY LAGOON,**
Louisiana State Univ., Baton Rouge. Agricultural Experiment Station; and Louisiana State Univ., Baton Rouge. Dept. of Microbiology; and Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering; and Louisiana State Univ., Baton Rouge. Dept. of Poultry Science.
Leon J. Cabes, Jr., Arthur R. Colmer, Harold T. Barr, and Benjamin A. Tower.
Poultry Science, Vol 48, No 1, p 54-63, 1969. 2 fig, 3 tab, 17 ref.

Descriptors: *Farm wastes, *Poultry, *Oxidation lagoon, Microorganisms, E. coli, Aeration, Sampling, Coliforms, Bacteria, Pathogenic bacteria, Temperature, Hydrogen ion concentration, Biochemical oxygen demand, Aerobic bacteria, Waste water treatment.
Identifiers: *Laying house, *Bacterial counts, Enterococci, Suspended solids, Manometric studies.

The study was concerned, first, with the enumeration, isolation, and classification of the predominant bacterial flora of an indoor poultry waste stabilization lagoon, and secondly, with an evaluation of this flora to determine the organisms most active in the degradation process. The lagoon consisted of a pit 3 feet 6 inches deep x 13 feet wide x 88 feet long inside a laying house which measured 14 feet x 100 feet. The standard plate counts of aerobic organisms present in the waste water of the lagoon are presented in tabular form. Total solids, pH and BOD reduction data are also presented. The lagoon was aerated with 200 feet of perforated pipe which feed 4 cfm of air at 15 psi. It is felt that additional modifications might be instituted. (White-Iowa State)

### 0361-A11,B2,C2,D3,E3

**NUTRITIVE VALUE OF OXIDATION-DITCH RESIDUE,**
Illinois Univ., Urbana.
B. G. Harmon, A. H. Jensen, and D. H. Baker.
Journal of Animal Science, Vol 29, No 1, p 136, July 1969.

Descriptors: *Nutrients, Farm waste, Feeds, Value, Aerobic treatment, Diets, Amino acids, Energy, Waste water treatment.
Identifiers: *Excreta, *Swine, Feed value, Oxidation-ditch, Rats.

Swine excreta suspended in water and adjutated to promote aerobic digestion was studied as a source of nutrients. In four growth trials 132 weanling rats were used to study the nutritive value of amino acids and energy contained in the oxidation-ditch residue (ODR). The digestible energy decreased linearly as ODR was added to the diet. (Christenbury-Iowa State)

### 0362-C3

**DISTRIBUTION OF BACTERIA IN FECES OF SWINE,**
Missouri Univ., Columbia.
Gloria D. Rall, Arletta J. Wood, R. B. Wescott, and A. R. Dommert.
Applied Microbiology, Vol 20, No 5, p 789-792, Nov 1970. 3 tab, 2 fig, 12 ref. Public Health Service grants RR-00390 and RR-00285.

Descriptors: *Bacteria, *Distribution, Farm wastes, Patterns, Microorganisms, Pollutant identification.
Identifiers: *Fecal samples, *Swine, Frequency, Distribution.

A new technique is described for evaluating bacterial cell distribution in fecal samples. Spatial relationships of cells within an area rather than number of cells per unit volume or weight are measured by this technique. Measurements of cell distribution by this method indicated that bacteria occurred in freshly voided swine feces as pure, discrete colonies rather than as single cells distributed randomly or uniformly throught the sample. (Christenbury-Iowa State)

### 0363-A6, C1, C2

**ODOR TRANSPORT BY PARTICULATE MATTER IN HIGH DENSITY POULTRY HOUSES,**
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
William E. Burnett.
Poultry Science, Vol 48, No 1, p 182-185, 1969. 1 fig, 1 tab, 9 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, Gas chromatography, Volumetric analysis, Volume, Filters, Nitrogen, Organoleptic properties, Ventilation, Pollutant identification, Air pollution, Pollution abatement.
Identifiers: *Particulate matter, Odor transport, Odor panel, Volatiles, Concentrations, Odoriferous components.

The report investigates the concentrations of airborne particulate matter in a high density poultry house and the role of particulate matter as an odor transport mechanism. Particulate matter collected by high volume samplings, of a commercial poultry house atmosphere revealed that the particulates had a 'chicken house' odor. Gas chromatographic analyses of the volatiles carried by the particulates revealed the presence of a number of individually odoriferous compounds. Large quantities of particulate matter are probably expelled from poultry houses by ventilation fans. Whether particulate matter plays a significant role in ambient odors from poultry houses should be investigated since the particulates represent a retentive source of odors. (White-Iowa State)

### 0364-C1, C2, D1, D2

**LOSSES OF ENERGY AND NITROGEN ON DRYING POULTRY EXCRETA,**
Queen's Univ., Belfast (Northern Ireland). Dept. of Agricultural Chemistry.
D. W. F. Shannon, and W. O. Brown.
Poultry Science, Vol 48, p 41-43, 1969. 1 tab, 3 ref.

Descriptors: *Farm wastes, *Poultry, Energy, Nitrogen, Drying, Freeze drying, Vacuum drying, Forced drying, Temperature, Waste treatment.
Identifiers: Kjeldahl nitrogen, Metabolizable energy, Dry matter.

Losses of energy and nitrogen were determined from samples of fresh excreta differing in dry matter and nitrogen content. The samples were dried under the following conditions - feeze drying, vacuum drying at 40C and drying in forced-air ovens at 60C, 100C, and 120C. Nitrogen of the undried and dried excreta was determined by the conventional Kjeldahl method. The mean results of ten energy determinations (%) on fresh excreta samples A and B were 804, 753, 2.51 respectively. The energy losses are in agreement with other authors. From the results of the experiment, the drying temperature should be chosen depending on whether the energy or nitrogen content is more important. In the determination of metabolizable energy, then the method giving lower energy errors would be used. (White-Iowa State)

## 0365-A4, A5, A8, A9

### AGRICULTURE FACES NEW CHALLANGES IN CURRENT ENVIRONMENTAL CRISES,

Department of Agriculture, Washington, D.C. Science and Education.
Ned D. Bayley.
Water and Wastes Engineering, Vol 7, No 11, p F-14 - F-16, November 1970. 4 fig.

Descriptors: Farm wastes, Water, Water resources, Pesticides, Salinity, Sediments, Water pollution control, Fertilizers, Planning.
Identifiers: Soil spoiler.

The responsibility of agriculture in enhancing the quality of the environment is colossal. This is because agriculture, including forestry, involves more natural resources than any other segment of society. Wise planning in the use of land, water, chemicals, and waste disposal techniques must be demanded, and it must be done now. This paper outlines some of the problems and difficulties encountered in dealing with agricultural pollutants. (Christenbury-Iowa State)

## 0366-A6, B2, D3, E2, F1

### LIQUID HANDLING OF POULTRY MANURE,

Massachusetts Univ., Amherst. Dept. of Agricultural Engineering.
Curtis A. Johnson.
ASAE Paper No NA 64-501. Transactions of the American Society of Agricultural Engineers, Vol 8, p 124-126, 1965. 2 fig, 1 tab, 6 ref.

Descriptors: *Liquid waste, *Order, *Septic tanks, *Water reuse, Farm waste, Sludge disposal, Poultry, Ammonia, Disposal, Design criteria, Cost comparisons, Effluents, Waste water treatment.
Identifiers: *Recycling, Liquid-manure handling, Ammonia odor, Congdon system.

This article describes an integrated system concept for liquid manure handling of waste produced by laying hens in conventional commercial cage units. The bird droppings in this unit collect in 8 inch deep, 44 inch wide troughs formed on original floor with 4 inch thick concrete blocks. The lower end of each sloped trough is closed with a 2 inch x 6 inch board. These boards are removed to empty the troughs into a 24 inch by 24 inch trench running across the end of the building below floor level. This sloping trench empites into a 12 inch diameter plastic pipe which conveys the waste to an underground septic tank. From the third compartment of this three-compartment tank the effluent is pumped back into the laying house to hydraulically clean the troughs beneath the cages. The effluent becomes increasingly concentrated. The effluent is periodically pumped onto forest land and the sludge is 'batch' handled. This manure system provides: (1) Easy manure handling, (2) Few moving parts, (3) Little ammonia odor, (4) Low water usage, (5) Simple manure disposal, (6) Low-cost pit cleaning. (Parker-Iowa State)

## 0367-B5, C2

### NITROGEN AND AMINO ACIDS IN THE FECES OF YOUNG PIGS RECEIVING A PROTEIN-FREE DIET AND DIETS CONTAINING GRADED LEVELS OF SOYBEAN OIL MEAL OR CASEIN,

Guelph Univ. (Ontario). Dept. of Nutrition.
Kathleen H. Carlson, and H. S. Bayley.
Journal of Nutrition, Vol 100, No 11, p 1353-1361, 1970. 5 tab, 3 fig, 17 ref.

Descriptors: *Nitrogen, *Amino acids, *Proteins, *Diets, Farm wastes, Hogs, Water pollution sources.
Identifiers: Young pigs, Protein-free diets, Casein, Soybean oil meal.

Thirty-two piglets were weaned at 14 days of age and received a nutritionally complete diet; at 20 days of age they were allocated to either a protein-free diet, or diets containing 7, 14, or 21% protein from either soybean oil meal or casein. Feed consumed between 21 and 31 days of age was measured and the feces voided were collected. The n-butyl-N-trifluoroacetyl esters of the amino acids in hydrolysates of feed and feces were separated by gas-liquid chromatography. The amounts of fecal nitrogen and of each of the 13 amino acids of metabolic origin were calculated directly from the observations made on the protein-free diet and indirectly by regression analyses of the outputs of the piglets receiving the diets containing graded levels of protein. The metabolic fecal nitrogen excretion determined directly (111 mg. N.100 g. feed consumed) agreed more closely with other published values than the indirect estimates obtained by regressions. The direct values were used in calculating the corrected digestibilities of the nitrogen and of the amino acids in the two protein sources. The corrected digestibilities of the nitrogen and amino acids in the casein were very high (97 - 100%), but were lower for the soybean meal. There were significant differences in the corrected digestibilities of the individual amino acids in the soybean oil meal, which ranged from 82% for alanine to 93% for glutamic acid. The level of inclusion of casein did not influence the corrected digestibilities of the amino acids, but increasing the level of soybean oil meal in the diet caused a significant reduction in the corrected digestibilities of isoleucine, leucine and proline. (Christenbury-Iowa State)

## 0368-A4, A5, A6, A8, A11, A12, A13, D1, D2, D3, E2, E3, F1

### AGRICULTURE WASTE RESEARCH NEEDS,

Cloisterdale Farms, Ephrata, Pa.
Glenn H. Herr.
Compost Science, Journal of Waste Recycling, Vol 11, No 5, Sept-Oct 1970, p 8-11. 4 fig.

Descriptors: *Farm waste, *Poultry, *Disposal, *Drying, Odor, Costs, Equipment, Aeration, Lagoons, Irrigation, Waste water treatment.
Identifiers: SHUD, Neighbors.

The author is responsible for disposal of 17,000 plus or minus tons of raw waste annually from a laying hen complex of 360,000 hens. Their problems incidental to poultry 'SHUD' were: first - volume accumulation of shud within houses, second - community relations - odor primarily; danger of soil and water pollution secondarily. Third - ultimate disposal, and, finally fourth - the unknown factor of the possibility of, or the effect of, gas toxicity to the chickens and humans. Some of their attempted and/or considered methods for disposal were the use of: (1) lagoons; (2) irrigation; (3) sewage treatment plant; (4) incineration; (5) burying; (6) hauling and spreading; future consideration: (7) semidrying; (8) possible dehydration - which might lead to: fertilizer products; re-feeding; or some other uses. Their conclusion was that liquid handling would not be the long range answer to their problems. They concluded that some method of dry or semi-dry procedure must develop as their solution and as an industry solution. Mr. Herr describes the system of drying the manure in place and the cost of disposal of the simi-dried (30%) SHUD. (Christenbury-Iowa State)

## 0369-B1, B5, C1, C2, D3

### ANAEROBIC DECOMPOSITION OF SWINE EXCREMENT,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
O. E. Cross, and Alvaro Duran.
Nebraska Agricultural Experiment Station Journal Paper No 2531. Transactions of the ASAE, Vol 13, No 3, May 1970, p 320-322. 11 fig, 7 ref.

Descriptors: *Farm wastes, Laboratory tests, *Anaerobic digestion, *Hogs, Anaerobic conditions, Temperature, Sludge, Biochemical oxygen demand, Hydrogen ion concentration, Waste water treatment.
Identifiers: Swine, Loading rates, Volatile solids, Detention times, Digesters.

This paper presents a laboratory analysis on the anaerobic digestion of swine excrement as affected by temperature and loading rate. The tests were run for 15 days. The experiments were conducted using ambient temperatures of 50, 70, and 90 F. at three loading rates. The loading rates were 3.2, 1.6, and 0.8 g. of volatile solids per liter of digester volume per day. Volatile-solids content was determined daily during a 15-day test period. Moisture content, total solids, fixed solids and pH were also determined daily. A 5-day BOD test was performed. None of the experiments reached equilibrium; however, it was possible to detect a tendency of the system to approach equilibrium or to approach failure. The results showed that for a load of 0.8 g. at all temperatures the system indicated success in the digestibility of the organic matter. At a load of 3.2 g. at 70 F and 50 F the system tended toward failure. (Christenbury-Iowa State)

## 0370-A8, C2, E2

### EFFECT OF SOIL TEMPERATURE ON THE AVAILABILITY OF PHOSPHORUS IN ANIMAL MANURES,

California Univ., Davis.
J. L. Abbott, and J. C. Lingle.
Soil Science, Vol 105, No 3, p 145-152, 1968. 3 tab, 5 fig, 14 ref.

Descriptors: *Farm wastes, *Phosphorus, Water pollution effects, Nutrients, Organic matter, Nitrogen, Carbon dioxide, Soil temperature, Plant growth.
Identifiers: *Animal manure, Available phosphorus, Plant response.

Steer, dairy, sheep, and poultry manures, and alfalfa supplemented with monocalcium phosphate added to two slightly acid soils at the rate of 50 ppm. total P and supplied plant-available P to two successive crops - turnips and tomatoes. Dry-weight yield and total P in the tissues provided data for evaluating plant-available P in the manures. In the Sierra sandy loam at the medium soil temperature, uptake of P by turnips was greater from the sheep, poultry, and alfalfa plus PO4 treatments than from the dairy manure treatment. In the Gridley clay loam at 15 deg C. soil temperature, uptake of P by turnips was greater from the poultry manure treatment than from the other treatments. Soil temperature had no measurable effect on the availability of manurial P to tomatoes. At all soil temperatures, P-solubilizing processes, including mineralization of the organic P in both soils and amendments, appeared to contribute to the P absorbed by plants. These processes appeared to continue during the second cropping period, notably at the low (20 deg C.) soil temperature, after having been previously cropped for 5 weeks and incubated fór 3 weeks at 15 deg C. Manures yielded more available P in the Sierra than in the Gridley soil. From these data, the HOAc-soluble:nonsoluble P ratios of manures could not be said to have influenced the availability of manurial P to plants. On an equal dry-weight basis, the overall effectiveness of manures in supplying available P depended on their respective total P contents: poultrySsheepSsteer — dairy. (Christenbury-Iowa State)

## 0371-A6, A10, B2, C1, C2, D1, E2

**THIN SPREADING OF SLURRIED MANURES,**
California Univ., Davis. Dept. of Agricultural Engineering.
Samuel A. Hart.
Transactions of the American Society of Agricultural Engineers, Vol 7, 1964, p 22-28. 9 fig, 3 tab, 21 ref.

Descriptors: *Farm wastes, *Slurry, *Drying, Cattle, Hogs, Poultry, Moisture content, Viscosity, Pumps, Bulk density, Volume, Nitrogen, Odor, Organic matter, Carbon dioxide, Waste water treatment.
Identifiers: *Spreading, *Thin spreading, *Fluidization, Liquefaction, Solids per cent, Fly breeding, Slump, Layers, Layer thickness, Surface area.

The purpose was to determine how thick a layer of manure could be spread, day after day, layer upon layer, and still prevent fly breeding or other sanitation problems. Chicken and dairy manure was fluidized to 10 to 20 percent solids, and then spread in layers on two sets of six plots. The six plots in each series were dosed with increasing thicknesses of manure: from 1/25 to 1/4 inch for the chicken plots; 1/20 to 3/10 inch for the dairy plots. A specific plot received the same dose at each of the 47 applications. At a solids content of 85 percent, fly breeding was prevented. A significant amount of organic matter is lost during drying and storage, the loss being related to the moisture content of the plot. One-half of the nitrogen originally present in the manure is also lost. The land area needed for cumulative layering is not large - less than 200 sq. ft. per cow and 1 sq. ft. per chicken. Odors can and do occur in manure thin spreading, but can be minimized by layering of fresh manure only. (White-Iowa State)

## 0372-A2,A4,A5,B2,B4,C1,C2,C3,D2,E1,E2

**DRAINAGE AND POLLUTION FROM BEEF CATTLE FEEDLOTS,**
Cornell Univ., Ithaca, N.Y. Dept. of Civil and Agricultural Engineering.
Raymond C. Loehr.
Journal of the Sanitary Engineering Division, ASCE, Vol 96, No SA6, p 1295-1309, 1970. 4 fig, 1 tab, 26 ref.

Descriptors: *Drainage, *Water pollution, *Cattle, Runoff, Groundwater, Nutrients, Biochemical oxygen demand, Rainfall, Chlorides, Nitrogen, Ammonia, Phosphates, Chemical oxygen demand, Acids, Water pollution sources, Water pollution effects, Bacteria, Retention, Waste disposal, Management, Water pollution control.
Identifiers: *Feedlots, Animal production, Cattle wastes, Volatile acids, Land application.

The specialization of the livestock production industry established the trend of confinement feeding and increasing animals per feeding operation. Uncontrolled waste discharges from these operations are a source of water pollution by excessive nutrients, microorganisms impairing recreation waters, impurities in groundwater, contaminants that complicate water treatment, and dissolved oxygen depletion causing fish kills. Runoff from concrete surfaced feedlots contains higher organic matter and nitrogen concentrations than runoff from unsurfaced. Groundwater contamination from nitrates is significant during and after the lot life. Absorption of ammonia volatilized from cattle feedlots can contribute to nitrogen enrichment of surface waters in their vicinity. In the midwest and southwest, retention ponds with controlled discharge and retention-evaporation ponds can provide satisfactory control and treatment. Approved facilities in Kansas include runoff diversion, retention ponds for all waste water and runoff contacting animal wastes and application of both liquid and solid wastes to agricultural land. Enclosed housing beef cattle production will minimize contamination of runoff and avoid runoff pollution problems. (Jones-Wisconsin)

## 0373-A10, B1, C3, D3

**ARTHROPOD PREDATORS OF IMMATURE DIPTERA DEVELOPING IN POULTRY DROPPINGS IN NORTHERN CALIFORNIA: PART I,**
California Univ., Berkeley. Dept. of Entomology and Parasitology.
John H. Peck, and John R. Anderson.
Journal Medical Entomology, Vol 6, No 2, p 163-167, May 31, 1969. 4 tab, 19 ref.

Descriptors: *Poultry, *Diptera, Farm wastes, Biocontrol, Sampling, California, Seasonal, Mosture content, Animals, Mites.
Identifiers: *Arthropod predators, Fly control, Filth flies, Cohabitation, Poultry droppings, Predatory fauna, Coleoptera, Enumeration.

Arthropod predators occurring in manure at 2 Sonoma County, California, poultry ranches were identified and studied. Seasonal abundance and association with prey were determined for the following major predators: Macrocheles muscaedomesticae, Glyptholaspis confusa, Fuscuropoda sp., Carcinops pumilio, Margarinotus merdarius, Philonthus politus, P. sordidus, Staphylinus maxillosus villosus, Muscina stabulans, and Ophyra leucostoma. (White-Iowa State)

## 0374-A10, B1, C3, D3

**ARTHROPOD PREDATORS OF IMMATURE DIPTERA DEVELOPING IN POULTRY DROPPINGS IN NORTHERN CALIFORNIA: PART II,**
California Univ., Berkeley. Dept. of Entomology and Parasitology.
John H. Peck.
Journal Medical Entomology, Vol 6, No 2, p 168-171, May 31, 1969. 4 tab, 15 ref.

Descriptors: *Poultry, *Diptera, California, Seasonal, Predation, Mites, Mortality, Insect eggs, Larvae, Light, Farm wastes.
Identifiers: *Arthropod predators, Predation potential, Media cohabitation, Pupae, House fly eggs, Variance, Poultry droppings.

The feeding responses of 3 species of predaceous Staphylinidae and 2 species of predaceous Histeridae were studied by exposing them to eggs, larvae and pupae of Musca domestica and Fannia femoralis. Studies of age-of-prey specific predation by M. muscaedomesticae on immature M. domestica showed that most mortality was inflicted on eggs and first instar larvae. Predation rates were determined for the above and 6 other predaceous species; the following indices of predation potential were computed for the 5 most abundant predators: Fuscuropoda sp. (adults) - 3.5, Glyptholaspis confusa females - 4.4, Macrocheles muscaedomesticae females - 95.8, Carcinops pumilio (adults) - 97.0, and Ophyra leucostoma L3 - S226.4. The potential importance of the above predators is discussed with reference to their seasonal and media cohabitation with various prey species. (White-Iowa State)

## 0375-A3, A8, A9, C1, C2, C3, E2

**RURAL RUNOFF AS A FACTOR IN STREAM POLLUTION,**
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
R. H. Weidner, A. G. Christianson, S. R. Weibel, and G. G. Robeck.
Journal Water Pollution Control Federation, Vol 41, No 3, p 377-384, March 1969. 10 tab, 6 fig, 3 ref.

Descriptors: *Surface runoff, *Water pollution, Farm wastes, Storm runoff, Water quality, Acreage, Cultivated lands, Grasslands, Pastures, Forests, Urbanization, Land use, Nitrogen, Phosphorus, Soil erosion, Watersheds, Physical characteristics, Slopes, Fertilizers, Pesticides, Mulching, Flow measurement, Sampling, Flumes, Coliforms, Precipitation, Rainfall intensity, Time, Corn, Regression analysis, Biochemical oxygen demand, Chemical oxygen demand.
Identifiers: Soil characteristics, Measuring flume.

The results of this work indicate that rural runoff is a factor in stream pollution and that it must be considered when one evaluates the quality of any stream or receiving body of water. However, there also must be an awareness that there are some means available for reducing this pollutional load. This study showed that, despite an increase in the amount of fertilizers and manure applied under improved practices, there was a marked decrease in the amount of pollutional load that came from these watersheds as contrasted to the load from watersheds using prevailing practices. Runoff, soil loss, and microbial densities were considered. (White-Iowa State)

## 0376-C3

**EVALUATION OF SEVERAL METHODS OF ISOLATING SALMONELLA FROM POULTRY LITTER AND ANIMAL FEEDSTUFFS,**
Massachusetts Univ. Amherst. Dept. of Veterinary and Animal Sciences.
C. F. Smyser, and G. H. Snoeyenbos.
Avian Diseases, Vol 13, No 1, p 134-141, 1969. 5 tab, 13 ref.

Descriptors: *Salmonella, *Poultry, Bacteria, Farm wastes, Microorganisms, By-products, Incubation, Sampling, Frequency.
Identifiers: *Poultry litter, *Feedstuffs, Enrichment broths, Selenite broth, Animal by-products, Feed mills, Rendering plants, Tetrathionate broth, Significant difference, Proteus.

A comparison of several different culture procedures for Salmonella isolations, using selenite-brilliant green-sulfapyridine (SBG sulfa) and tetrathionate brilliant green (TBG) as enrichments was made with 198 litter samples of which 161 were positive by one or more methods, and with 371 animal feedstuff samples of which 111 were positive by one or more methods. All enrichments were streak-plated after 48 hour incubation. SBG sulfa incubated at 43C was superior to SBG sulfa at 37C, and to TBG at 37C with or without pre-enrichment for the isolation of salmonellae from poultry litter and animal feedstuffs. Significantly more samples of animal feedstuffs yielded salmonellae from SBT sulfa at 43C than from the other two media. More salmonella colonies and fewer competing organisms were usually obtained on BG agar plated from SBG sulfa at 43C than from either SBG sulfa at 37C or TBG. SBG sulfa appeared to be a more favorable enrichment medium than TBG for isolating S. senftenberg; differences in the number of isolations among several other serotypes were too small for comparison. (White-Iowa State)

## 0377-A8, E2

**EFFECTS OF ORGANIC MANURES ON SOILS AND CROPS,**
Reading Univ. (England). Dept. of Agricultural Botany.
A. H. Bunting.

Proceedings Nutrition Society, Vol 24, No 1, p 29-34, 1965. 4 tab, 14 ref.

Descriptors: *Soils, *Crops, *Organic matter, Fertilizers, Farm wastes, Nitrogen, Phosphorus, Potassium, Crop production, Nutrients, Wheat, Potatoes, Sewage sludge, Calcium, Fertility, Temperature, Moisture content, Soil structure.
Identifiers: *Farmyard manure, *Organic manures, Mineral fertilizers, Sludge compost, Minor elements.

The paper reports on the effects organic manure, and especially farmyard manure, has on different soils and crops. The effects of organic manures on crops are often important, but they are largely associated with changes in the supply of nutrients. However, there is good evidence that on some special soils, they have special effects on crop growth. The paper then focuses on changes which take place in the soil as a result of organic matter addition. Moisture content and soil structure are most particularly affected. (White-Iowa State)

## 0378-B2, C1, C2, D1, D3, F3

### TREATMENT OF LIVESTOCK WASTE – A LABORATORY STUDY,

Missouri Univ., Columbia. Dept. of Sanitary Engineering; and Missouri Univ., Columbia. Dept. of Agricultural Engineering.
E. A. Jeffrey, W. C. Blackman, and Ralph Ricketts.
Transactions of the American Society of Agricultural Engineers, Vol 8, No 1, 1965, p 113-117, 126. 6 fig, 5 tab, 17 ref.

Descriptors: *Farm wastes, *Lagoons, *Anaerobic digestion, *Hogs, Aerobic treatment, Lagoons, Cattle, Sheep, Aeration, Sludge, Domestic wastes, Hydrogen ion concentration, Digestion tanks, Biochemical oxygen demand, Chemical oxygen demand, Waste dilution, Nitrification, Manometers, Design standards, Design criteria, Waste water treatment.
Identifiers: *Aerobic lagoon, Agitation, Volatile solids, Total solids, Beuch scale aerators, BOD/COD ratio, Detention time.

A study was made of the aerobic and anaerobic digestion characteristics of livestock wastes. The results obtained in the hog waste digestion studies are compared to design criteria for domestic sludge digestion units. Design loading conditions and water requirements are calculated for using an anaerobic lagoon for treating hog wastes. Design requirements for an aerobic lagoon are also indicated. It is concluded that disposal of hog wastes by use of aerobic lagoons is prohibitive because of the large requirements of both water and land area. The use of anaerobic lagoons is feasible, but it is accompanied by the problem of eventually having to dispose of the accumulated digested sludge. Future studies should be made on the operation of series lagoons. By using the first lagoon for settling and as an anaerobic lagoon, the area requirement of the second to serve as an aerobic lagoon would be greatly reduced, perhaps to the point of practicality. (White-Iowa State)

## 0379-A6, A10, A12, B3, D3, E3

### A REPORT ON THREE MANURE COMPOSTING PLANTS,

Public Health Service, San Francisco, Calif.
John S. Wiley.

Compost Science, Vol 5, Summer 1964, p 15-16. 3 fig.

Descriptors: *Farm wastes, Public health, Cattle, Poultry, Organic wastes, Aerobic conditions, Anaerobic conditions, Mositure content, Aeration, Odor, Pathogenic bacteria, Screens, Nitrogen, Ammonia.
Identifiers: *Composting, *Aerobic decomposition, Nuisance, Fly production, Windrow composting, Rotary drum composter, Soil conditioner.

The article describes three manure composting plants which process manure in a sanitary, economical manner and use the product as a soil conditioner. One plant treats a mixture of feedlot manure from 5500 steers and meat packing wastes in long windrows which are turned six times during the six week composting period. The other two plants treat poultry manure in rotary drum composters. Each of these two plants treats wastes from one million birds. The compost is sold as a humus plant food. The three plants are interesting attempts to process manures in a sanitary manner and to utilize the resulting product for the benefit of the soil. (White-Iowa State)

## 0380-A4, A8, C2, E2

### TWO BILLION TONS OF - WHAT,

Department of Agriculture, Beltsville, Md. Livestock Engineering and Farm Structures Research Branch.
Harry J. Eby.
Compost Science, Vol 7, p 7-10, Autumn 1966. 2 fig.

Descriptors: *Farm wastes, *Volume, *Organic wastes, Domestic wastes, Cattle, Poultry, Nutrients, Value, Organic matter, Topsoil, Turf, Water pollution, Percolation, Fertilizers, Filters.
Identifiers: *Waste production, *Grass belts, *Composting, Population equivalent, Land disposal, Pollution control.

The author advocates managing our millions of tons of organic waste, both farm and municipal, in such a way that grass belts would be planted along the borders of streams and rivers. The organic wastes would be worked into these areas in large quantities to improve the quality of the soil. His proposal is based on three factors: (1) Soil with a high organic content holds more water than soils with little organic content. (2) Incorporating organic matter into a clay soil improves its percolation rate as well as its water-holding capacity. (3) Soil is a good bacterial filter. Thus the grass belts would act as a means of stream and river pollution control. The author feels that more research is needed to find components of manure which would have continuing industrial or commercial applications. Examples are given illustrating the magnitude of the animal waste disposal problem. (White-Iowa State)

## 0381-A4, A61, A12, B2, B3 D1, D3, E2

### WASTES FROM PIG PRODUCTION UNITS,

Tay River Purification Board (Scotland); and North of Scotland Coll. of Agriculture, Aberdeen. Scottish Farm Buildings Investigation Unit.
R. A. Pontin, and S. H. Baxter.
Water Pollution Control, Vol 67, No 6, 1968, p 632-638. 4 tab, 4 fig, 11 ref.

Descriptors: *Farm wastes, *Hogs, *Activated sludge, Foaming, Freezing, Rotors, Effluent, Biochemical oxygen demand, Odor, Construction, Rubber, Linings, Recirculated water, Operations, Slurries, Sludge, Dissolved oxygen, Costs, Aeration, Water pollution, Public health, Lagoons, Anaerobic digestion, Filtration, Waste water treatment.
Identifiers: *Oxidation ditch, Slatted floor, Primary ditch, Secondary ditch, Suspended solids, Layout, Rubber sheeting, Continuous operation, Intermittent operation, Land disposal, Composting, Extended aeration.

Methods for the disposal or treatment of the increasing quantities of slurry from intensive pig production units are outlined. The possible application of the oxidation ditch for such treatment is discussed and the results of experiments of a commercial piggery are described. The authors conclude that the method offers the promise of an economic solution but that further research is urgently needed. (White-Iowa State)

## 0382-A4, C3, F1

### TYPE DISTRIBUTION OF COLIFORM BACTERIA IN THE FECES OF WARM-BLOODED ANIMALS,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
E. E. Geldreich, R. H. Bordner, C. B. Huff, H. F. Clark, and P. W. Kabler.
Journal Water Pollution Control Federation, Vol 34, No 3, March 1962, p 295-301. 4 tab, 24 ref.

Descriptors: *Coliforms, *Bacteria, *E. coli, *Farm wastes, Domestic wastes, *Temperature, Cattle, Hog, Sheep, Poultry, Membrane filters, Variability, Water pollution, Surface drainage.
Identifiers: Detection, Enumeration, IMViC, BALB, EC broth procedure, MPN test, Biochemical tests, Correlation.

This investigation examined the reactions of 4512 human, 2339 livestock, and 1896 poultry coliform strains isolated from 43 human, 32 livestock, and 28 poultry fecal samples. The EC procedure showed a 96.3 percent positive correlation and the BALB procedure a 95.3 percent correlation with the coliforms from fecal sources. These findings suggest that the presence of EC or BALB positive coliform strains in water or wastes indicate relatively recent fecal pollution. An occasional shift in percent positive correlation of the elevated temperature test for three human samples during a period of one to three years was noted. The biochemical tests comprising the IMViC typing classification are cumbersome and do not present as close a correlation with fecal origins of the coliform group as other procedures. In view of the excellant reliability of either the EC or BALB test for fecal coliform bacteria, and taking into account the saving in time and effort, the elevated temperature procedure seems to be the method of choice. (White-Iowa State)

## 0383-A4, A5, A7, B1, F2

### PORK PRODUCERS AND POLLUTION: LEGAL ASPECTS,

Missouri Univ., Columbia. Dept. of Agricultural Economics.
Donald P. Levi.
Paper delivered at the Annual Meeting of Missouri Pork Producers Association, January 16, 1970, Columbia, Missouri. Agricultural Economics Paper No. 1970-6. 15 p.

Descriptors: *Legal aspects, *Regulation, Farm wastes, Disposal, Missouri, Maintenance, Waste water treatment, Water pollution control.
Identifiers: *Pollution laws, *Lawsuits, Nuisance law, Liability, Stockmen, Law.

Pollution of water and air by feeding operations is becoming a very real problem. Whether this constitutes a nuisance is a question of fact and depends on the circumstances of each case. The relative interests of the parties involved will determine whether or not a given operation is closed down. Even if one is legally allowed to continue in business, the assessment of actual or punitive damages may make it unprofitable to do so. There is no one thing which farmers can do to guarantee that they be free from nuisance actions. Site selection, proper maintenance, zoning and licensing may help in some cases. (Christenbury-Iowa State)

## 0384-A2, A4, B1, C2, F1

### THE ECONOMICS OF CLEAN WATER: ANIMAL WASTES PROFILE.

Federal Water Pollution Control Administration, Washington, D.C.

For sale by Supt. of Documents, U. S. Govt. Printing Office, Washington, D. C. 20402. Price $1.00. March 1970. Vol 2, 85 p, 18 fig, 10 tab.

Descriptors: *Animal populations, *Farm wastes,

*Water pollution sources, *Water pollution control, *Cost analysis, Cattle, Sheep, Poultry, Hogs, Livestock.
Identifiers: *Animal wastes, *Clean water, *Feedlots, Swine, Milk cows, Stream pollution.

A comprehensive view is provided of the problem of farm-animal wastes in the United States in relationship to pollution of water bodies. A framework is established for estimating costs of animal wastes control to prevent water pollution. In many cases animal wastes have proved to be significant pollution sources that resulted in fish kills and extensive damage to the ecology of the streams. At the present time, however, there is general agreement that not all of the wastes need to be considered as sources of water pollution. Therefore, it would seem that entirely too much emphasis has been placed on the gross possible costs of controlling water pollution from animal wastes. A more realistic base for use in developing programs for water pollution abatement and control from animal wastes is a series of sub-elements that can be independently assessed to determine their pollution potential, applicable control measures, and total pollution control costs. Estimates are presented of the locations, by states, of populations of cattle, milk cows, swine, sheep, and poultry together with discussions of water pollution control practices, wastes discharge frequencies from feedlots, and climate effects.

### 0385-A7,A11,A13,F2,F4

**AIR POLLUTANTS AFFECTING THE PERFORMANCE OF DOMESTIC ANIMALS - A LITERATURE REVIEW.**

Agriculture Research Service, Washington, D.C.

For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $1.00. Agriculture Handbook No 380, Issued August 1970. 109 p, 666 ref.

Descriptors: *Domestic animals, *Air pollution effects, *Toxicity, Pollutant identification, Air pollution, Atmsophere, Smoke, Pollutants, Physiological Ecology, Legislation, Farm wastes, Laboratory studies, *Reviews, *Bibliographies, Water pollution effects.
Identifiers: Inhalation, Ingestion, Veterinary diagonosis, Esthetic effects, Automobile exhausts.

The results of a Literature Survey to determine the effects of air pollution on domestic animals is presented. The term 'domestic animals' as used in this report includes cattle, sheep, goats, swine, horses, chickens, turkeys, ducks, geese, pigeons, Japanese quail, dogs, cats, rabbits, and honey bees. Chapters 2, 3, and 4 on air pollution, smoke, and automobile exhausts provide a brief background on the generalities of these pollutants and their effects on domestic animals. Many of the specific air pollutants found in the air, smoke, and automobile exhausts are described in subsequent chapters, which contain a brief introduction of the air pollutant, the published results, a summary, and a bibliography. (Christenbury-Iowa State)

### 0386-A2,A3,A4,A6,A9,B1, C2,C3,E3

**INTRODUCTION: ISSUES IN FOOD PRODUCTION AND CLEAN WATER,**

Agricultural Research Service, Beltsville, Md. Water Conservation Research Div.
Cecil H. Wadleigh, and Clarence S. Britt.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Introduction, p xix-xxvii. 1 tab, 3 fig, 4 ref.

Descriptors: *Farm wastes, *Environment, Cattle, Poultry, Hogs, Ammonia, Fertilizers, Nitrogen, Corn, Labor, Nutrients, Potassium, Biochemical oxygen demand, Runoff, Fishkill, Effluent, Pesticides, Coliforms, Nitrates, Eutrophication, Phosphorus, Oxygen, Fish, Conservation, Lagoons, Odor, Sprinkler irrigation, Water quality.
Identifiers: *Waste production, *Feedlots, Mechanization, Chicken litter.

The article introduces the subject matter and contents of the book. A look is first taken at the increased consumption of meat in this country. From the total number of animals raised for slaughter, an idea is given of the amount and scope of the animal waste disposal problem. To raise this large number of animals the agricultural industry has relied on a variety of chemical fertilizers and pesticides to increase yields. Runoff from feedlots and agricultural lands has caused eutrophication and associated fish kills. However these are not the only nutrient sources. Conservation practices are needed to prevent water flowing through feedlots to run directly into a water course. As such secondary or even tertiary lagoons may be required. Recycling of wastes should be the optimum means of disposal. Sound conservation farming is needed to assure beneficial use of agricultural wastes and to effectively protect the quality of water in our streams and reservoirs. (White-Iowa State)

### 0387-A4, A8, F3, F6

**POLLUTION BY SEDIMENT: SOURCES AND THE DETACHMENT AND TRANSPORT PROCESSES,**

Iowa State Univ., Ames. Dept. of Agricultural Engineering; and Agricultural Research Service, Beltsville, Md. Water Conservation Research Div.
H. P. Johnson, and W. C. Moldenhauer.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 1, p 3-20. 2 tab, 2 fig, 59 ref.

Descriptors: *Water pollution, *Sediments, *Sediment transport, Bed load, Suspended load, Soil erosion, Gully erosion, Sheet erosion, Rill erosion, Sediment yield, Watersheds, Iowa, Losses, Regression analysis, Specific weight, Streams, Yield equations.
Identifiers: *Detachment, *Erosion equation, Universal Soil Loss Equation, Correlation coefficient, Sediment delivery ratio, Reservoir sedimentation.

The paper attempts to identify problems in the sediment pollution area, define the present understanding of the erosion and transport process, and to indicate research needs. Gross erosion from land, including both sheet and gully erosion, is discussed, and empirical methods of quantitative measurement are presented as well as research approaches. Primary sources of sediment yield information are reservoir sedimentation surveys and suspended load samplings. Finally a look is taken at sediment in transport and its two components suspended load and bed load. The science of erosion and sediment transport needs to advance considerably if it is to be sufficiently flexible for use in detailed planning. (White- Iowa State)

### 0388-A4, A8, C2

**CHEMISTRY OF SEDIMENT IN WATER,**

Agricultural Research Service, Morris, Minn. Soil and Water Conservation Research Div; and Minnesota Agricultural Experiment Station, St. Paul.
R. F. Holt, R. H. Dowdy, and D. R. Timmons.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 2, p 21-34. 2 fig, 1 tab, 49 ref.

Descriptors: *Sediments, *Nitrogen, *Phosphorus, Chemistry, Water pollution, Clays, Mineralogy, Montmorillonite, Illite, Colloids, Clay minerals, Organic matter, Ions, Ion exchange, Cation exchange, Anion adsorption, Oxidation-reduction potential, Nitrification, Denitrification.
Identifiers: Preferential removal, Electrical charge, Surface area, Reduced layer, Surface oxidized layer.

Sediment can be considered a major pollutant of surface waters. However, its contribution to the dissolved chemicals in lakes and streams is largely unknown. The composition of sediment closely resembles the soil from which it is derived but is generally higher in silt, clay, and organic matter. Chemical reactions involving sediment are essentially the surface chemistry of their colloidal fractions which is a function of their surface area and electrical charge. As a result, reactions with sediment can be divided into interactions with charged ions and with neutral compounds. The chemistry of sediments in situ can be surmised from studies of submerged soils. Sediments carry relatively large amounts of total nitrogen and phosphorus into surface waters, but in both cases only a small proportion of this total is readily available to the biosystem. Sediments apparently have a high capacity to remove phosphate from solution, but without turbulence the release of phosphate from bottom sediments will not support algal growth at appreciable distances from the sediment. Available inorganic nutrients, particularly phosphorus, are rapidly taken up by the biosystem in natural waters. They eventually become a part of the organic fraction of the sediment and their release back to the waters is not well resolved. (White-Iowa State)

### 0389-A3, A4, A8, B1

**LAND AND WATER MANAGEMENT FOR MINIMIZING SEDIMENT,**

Iowa State Univ. Ames. Dept. of Agronomy.
Minoru Amemiya.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 3, p 35-45. 5 tab, 28 ref.

Descriptors: *Land management, *Water management, *Sediments, *Soil erosion, Sediment yield, Soil stabilization, Sediment transport, Energy dissipation, Soil properties, Slopes, Farm management, Infiltration, Storage capacity, Vegetation, Velocity, Flow, Mulching, Erosion control, Cultivation, Runoff, Strip cropping, Terracing, Contour farming.
Identifiers: Detachment, Universal Soil Loss Equation.

The most logical and direct approach to solving our agriculturally related sediment problem is the stabilization of the sediment source by controlling soil erosion through the use of proper land and water management practices. An understanding of the factors affecting soil erosion by water is required in order to effectively protect the soil. The Universal Soil Loss Equation provides a framework for discussing erosion control measures. A vegetative cover or surface mulch is one of the most effective means of controlling runoff and erosion, and is discussed in some detail. A natural result of this fact is the creation of tillage methods which leave a mulch or crop residue on the surface. Examples of their effectiveness in controlling soil erosion are given. Contour farming, strip-cropping and terracing are slope modification methods for erosion control. Slope modification measures combined with soil conserving tillage practices can be effective in reducing soil erosion from cropped land. However, to become widely accepted, such practices must fit efficient farming operations and must be economically feasible. (White-Iowa State)

### 0390-A3, A4, A6, A8, B2, C2, E1, E2

**SIGNIFICANCE OF PHOSPHORUS IN WATER SUPPLIES,**

Southern Illinois Univ., Carbondale. Dept. of Botany.
Jacob Verduin.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 5, p 63-71. 1 fig, 4 tab, 12 ref.

Descriptors: *Phosphorus, *Nutrients, Water pollution, Fertilizers, Oxygen, Nitrogen, Sewage, Effluents, Phosphates, Carbon dioxide, Odor, Taste,

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Eutrophication, Water sheds, Tennessee Valley Authority Project, Detergents, Farm wastes, Lagoons.
Identifiers: *Plant nutrients, N/P ratio, Enrichment.

[illegible] author gives data showing the marked increase in total phosphorus concentrations in our streams and lakes. Although there has been a large increase in agricultural fertilizer use, evidence suggests that approximately one-third of the phosphorus contributions may come from agricultural watersheds. In urban sewage effluents, detergents seem to contribute about three times more phosphate than is contributed by the organic matter in sewage. Consequently, detergents would appear to be the most significant single source of phosphates enriching our waters today. The author contends that animal and domestic wastes belong on the land as fertilizer and soil improvers rather than discharging nutrient rich lagoon and sewage plant effluents directly to streams. As such, agriculture has a primary role to play in the solution of the pollution problem. In the problem of removing concentrated nutrients from water, agricultural technology can make a major contribution in the application of the living root zone filter to the process of plant nutrient removal. (White-Iowa State)

### 0391-A4, A5, A8, C2, E2

**BEHAVIOR OF SOIL AND FERTILIZER PHOSPHORUS IN RELATION TO WATER POLLUTION,**
Iowa State Univ., Ames. Dept. of Agronomy.
C. A. Black.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 6, p 72-93. 10 fig, 1 tab, 57 ref.

Descriptors: *Phosphorus, *Soils, Water pollution, Phosphates, Fertilizers, Solubility, Organophosphorus compounds, Groundwater, Surface waters, Aqueous solutions, Saturation, Distribution, Adsorption.
Identifiers: *Orthophosphate, Plant residues, Concentrations, Biological cycle, Phosphorite, Langmuir equation, Reaction capacity.

The principal objective of this chapter is to present an account of selected aspects of the behavior of soil and fertilizer phosphorus as a basis for understanding how phosphorus from these sources may contribute to the phosphorus content of waters in the soil and leaving the soil. Chemical and geologic phosphorus cycles in the soil are traced. The reactions and distribution of fertilizer phosphorus in soil are described. The distribution of both inorganic and organic phosphorus is pointed out. (White-Iowa State)

### 0392-A2, A3, A4, A5, C2, E2

**SOURCES OF NITROGEN IN WATER SUPPLIES,**
Geological Survey, Denver, Colo.
Marvin C. Goldberg.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 7, p 94-124. 4 fig, 8 tab, 72 ref.

Descriptors: *Nitrogen, *Nitrates, Groundwater, Ammonia, Precipitation, Sediments, Denitrification, Runoff, Ureas, Fertilizers, Drainage water, Irrigation, Return flow, Water supply, Livestock, Sewage, Infiltration, Industrial wastes, Algae, Ponds, Farm wastes.
Identifiers: *Surface waters, Geological sources, Mineralization, Nitrogen sources, Well water, Feedlots.

Water supplies can be categorized as surface waters or groundwaters. This paper examines representative studies of nitrate entrance to both types of water supplies, with summaries of some of the many laboratory and field studies described in the current literature. Some of the sources of nitrogen entrance to water supplies include atmospheric, geologic, rural and urban runoff, sewage, irrigation, animal wastes, and industrial wastes among many others. Sources of major importance to both surface and groundwater supplies are pointed out and field or laboratory studies are reported. (White-Iowa State)

### 0393-A5, A8, C2, D3, E2

**CHEMISTRY OF NITROGEN IN SOILS,**
Illinois Univ., Urbana. Dept. of Agronomy; and Missouri Univ., Columbia. Dept. of Agronomy.
F. J. Stevenson, and G. H. Wagner.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 8, p 125-141. 8 fig, 26 ref.

Descriptors: *Nitrogen, *Nitrates, *Ammonium compounds, Fertilizers, Inorganic compounds, Nitrites, Microorganisms, Climates, Nitrification, Denitrification, Leaching, Organic matter, Amino acids, Lignins, Chemistry, Soils.
Identifiers: *Fixation, Mineralization, Immobilization, Volatilization, Amines, Pyrimidine.

This review emphasizes the complex nature of soil nitrogen. Other than gaseous forms, the inorganic N consists primarily as NH4 (..) and NO3 (-). Part of the NH4 (..) is bound to colloidal surfaces and behaves according to classical reactions of exchange chemistry. Nitrate is free to move with the soil water and is the form of N which is of greatest concern from the standpoint of pollution of water supplies. Many soils contain appreciable amounts of NH4 (..) that cannot be utilized directly by plants and microorganisms; this NH4 (..) is held within the lattice structures of clay minerals. Less than one-half of the organic N in soils can be accounted for in known compounds (amino acids, amino sugars, purine and pyrimidine bases, etc.). The remainder may occur as part of the structures of humic and fulvic acids. Part of the N added to soils as fertilizers can be converted to organic forms by chemical reactions involving NH3 (..) and NO2 (-); this combined N is only slowly mineralized and may persist in soil for prolonged periods. Bacterial denitrification is an important factor regulating NO3 (-) levels in natural soil and may serve as a means of reducing the NO3 (-) content of groundwater when land is used for the disposal of nitrogenous wastes. (White-Iowa State)

### 0394-A3, A4, A5, A8, A9, A11, A12

**FERTILIZER MANAGEMENT FOR POLLUTION CONTROL,**
Minnesota Univ., St. Paul. Dept. of Soil Science.
W. P. Martin, W. E. Fenster, and L. D. Hanson.
Miscellaneous Publication Paper No 1360 of the University of Minnesota Agricultural Experiment Station, St. Paul. Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 9, p 142-158. 68 ref.

Descriptors: *Fertilizers, *Nitrogen, *Phosphorus, Nutrients, Phosphates, Soil erosion, Sedimentation, Sediments, Soils, Water supply, Eutrophication, Cultivation, Nitrates, Farm wastes, Wells, Water pollution, Nitrification, Irrigation, Denitrification.
Identifiers: *Pollution control, *Fertilizer use, Nutrient removal, Feedlots.

Nitrogen and phosphorus, as nutrient elements, are important to both land and aquatic plants, and normally reach water supplies via land runoff in the erosion debris. Fertilizer usages in the midcontinent area are rapidly increasing to maximize production and increase efficiency, and further increases are expected. Fertilizer phosphorus quickly converts to unavailable forms in mineral soils and the evidence indicates that one of the ways of reducing the level of soluble phosphorus in water would be to effect soil contact such as by filtration through the soil medium. Nitrogen fertilizer application rates should approximate crop needs, which for a given soil type and climatic zone are based on production potential estimates for the crops to be grown. Management recommendations refined through the years for maximizing production are not incompatible with the objective of reducing nutrient contamination of natural waters. Further research is needed on nutrient balances and reactions in soils to maintain supplies at levels needed for crop production. Water quality standards as established by the federal and state water pollution control groups should be compatible with the need for maintaining adequate nutrients for efficient crop production consistent with management programs designed to minimize losses to adjacent water supplies. (White-Iowa State)

### 0395-A4, A5, A7, A8, A9, A11, A12

**CHEMISTRY AND METABOLISM OF INSECTICIDES,**
Iowa State Univ., Ames. Dept. of Zoology and Entomology.
Paul A. Dahm.
Journal Paper No. J-6509 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter II, p 167-182. 6 fig, 1 tab, 62 ref.

Descriptors: *Insecticides, *DDT, *Aldrin, Dieldrin, Insects, Carbamate pesticides, Insect control, Metabolism, Organophosphorus pesticides, Chlorinated hydrocarbon pesticides, Pesticide toxicity, Pesticide residues.
Identifiers: Toxaphene, Parathion, Malathion, Carbaryl, Metabolites, Arthropods.

Insecticides occur in the environment because of purposive applications for pest control and because of accidents and carelessness. The major problems with insecticides arise from the contamination of the environment and food and the development of resistant arthropod-pest populations. The persistence of insecticides in the atmosphere, water, soil, plants, animals, and microorganisms is being investigated. Alterations of insecticides occur under both metabolic and nonmetabolic conditions. Knowledge of the metabolism of insecticides is prerequisite to their development and use for insect control. Identification and toxicological assessment of the metabolic products should precede establishment of residue and other safety factors. More basically, metabolism studies of insecticides reveal intoxication and detoxication processes and how these relate to physiological effects and problems of resistance. With some insecticides, primary metabolic attack may form compounds whose toxicity approximately equals or is greater than the parent insecticide. Numerous nonmetabolic factors exert effects on the structure and persistence of insecticides. The solubilities of insecticides in soil and water are especially important in relation to their movement and persistence in the environment. (White-Iowa State)

### 0396-A3, A4, A5, A9

**THE PESTICIDE BURDEN IN WATER AND ITS SIGNIFICANCE,**
Federal Water Pollution Control Administration, Athens, Ga. Southeast Water Lab.
H. Page Nicholson.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 12, p 183-193. 3 tab, 32 ref.

Descriptors: *Pesticides, *DDT, Toxicity, Dieldrin, Chlorinated hydrocarbon pesticides, Aldrin, Endrin, Heptachlor, Runoff, Water pollution, Industrial wastes, Insecticides.
Identifiers: *Environmental contamination, Concentrations, Sources, Parathion, Pesticide pollution.

Sources of pesticide polluted water include runoff, industrial wastes, accidents and carelessness.

Graphic examples of each are given to gain perspective about the potential for pesticide involvement in water pollution. The significance of chlorinated hydrocarbon pesticides with respect to water pollution is shown. Concentrations in some lakes and streams has increased. A final section on control of pesticide pollution gives ideas and methods which should result in less water pollution by pesticides. (White-Iowa State)

## 0397-A3, A9

### HERBICIDE RESIDUES IN AGRICULTURAL WATER FROM CONTROL OF AQUATIC AND BANK WEEDS,

Agricultural Research Service, Denver, Colo. Crop Research Div; and Agricultural Research Service, Laramie, Wyo. Crops Research Div.
F. L. Timmons, P. A. Frank, and R. J. Demint.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 13, p 194-208. 4 tab, 31 ref.

Descriptors: *Herbicides, *2-4-D, *Aquatic weed control, Dalapon, 2-4-5-T, Alligator weed, Copper sulfate, Ponds, Pond weeds, Reservoirs, Irrigation canals, Sprinkler irrigation, Furrow irrigation, Drainage, Water hyacinth, Runoff.
Identifiers: *Herbicide dissipation, Drainage ditches, Submersed weeds, Amitrole, Silvex.

The effectiveness of herbicides and the economics involved in agricultural production have caused their extensive use for weed control in and adjacent to aquatic areas, especially on irrigation systems. Greater use of herbicides in and around agricultural waters may be expected. Maximum residues of herbicides used for weed control in farm ponds and reservoirs are low, ranging from a fraction of 1 ppm to several ppm. In most cases these levels are of short duration. The transport of herbicide residues in irrigation water prevents extensive exposure of any given irrigated area. The flowing water may at times carry residues to areas where their presence may be objectionable. While reduction in residue level varies with canal and herbicide, many residues are dissipated after a water flow of 10 to 15 miles. In most cases, the dissipation can be attributed to dilution in water or absorption by bottom mud. The concentrations of herbicides found in irrigation water are unlikely to cause injury in crops. Where residues were found in crops following irrigation with water containing herbicides, the levels were generally much lower than tolerances already established for the same or similar crops. (White-Iowa State)

## 0398-A4, A5, A9, A10, F2

### PESTICIDES AND PEST MANAGEMENT FOR MAXIMUM PRODUCTION AND MINIMUM POLLUTION,

Iowa State Univ., Ames. Dept. of Zoology and Entomology.
Don C. Peters.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 14, p 209-223. 2 fig, 1 tab, 45 ref.

Descriptors: *Pesticides, *Pest control, Productivity, Water pollution, Climates, Insects, Control, Biocontrol, Cultural control, Chemcontrol, Mechanical control, Insecticides, Cotton, Timber management, Corn, Soybeans, Tobacco, Chlorinated hydrocarbon pesticides, 2-4-D, DDT.
Identifiers: *Pest management, Natural controls, Applied controls.

The author first discusses natural and applied controls which man utilizes in an effort to reduce losses caused by pests. Natural control can be subdivided into climatic, edaphic, and biotic aspects. Applied controls are biological, cultural, legal, or chemical practices. Examples of pest management in several areas of production are given. The role of agricultural pesticide use and clean water is pointed out. Suggestions are given, both legislative and practical, which can be used to reduce pesticide pollution of water. If the public demand for sophistication in pest control is to be achieved, more imaginative research support will have to be found.
(White-Iowa State)

## 0399-A2, A3, A4, A5, B2

### LIVESTOCK OPERATIONS AND FIELD-SPREAD MANURE AS SOURCES OF POLLUTANTS,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. R. Miner, and T. L. Willrich.
In: Agricultural Practices and Water Quality, 1970, Iowa State University Press, p 231-240. 2 tab, 25 ref.

Descriptors: *Pollutants, *Confinement pens, Farm wastes, Biochemical oxygen demand, Chemical oxygen demand, Runoff, Liquid wastes, Groundwater, Lagoons, Water pollution sources, Water pollution, Waste water treatment.
Identifiers: *Pollution characteristics, Lagoon effluent, Feedlot runoff.

This paper deals with the pollution potential from animal wastes. The pollution characteristics of animal wastes and the surface water and groundwater pollution potentials are discussed. Runoff is a primary mode of transportation of the waste to the water supplies. This pollution can be minimized through proper management.
(Christenbury-Iowa State)

## 0400-A8, C1, C2, C3, E2

### MANURE DECOMPOSITION AND FATE OF BREAKDOWN PRODUCTS IN SOIL,

Department of Agriculture, Lincoln, Neb.; and Iowa State Univ., Ames.
T. M. McCalla, L. R. Frederick, and G. L. Palmer.
In: Agricultural Practices and Water Quality, 1970, Iowa State University Press, p 241-255. 2 fig, 11 tab, 38 ref.

Descriptors: Farm wastes, Disposal, Fertilizers, Aerobic conditions, Anaerobic conditions, Microorganisms, Storage, Water pollution sources, Waste water treatment.
Identifiers: Fertilizer value, Composition, Breakdown, Decomposition.

This paper discusses the composition of animal manure. Fresh manure contains from 30 to 80% water. The rest of the constituents in manure are inorganic and organic solids, liquids, and gases. Manure contains all the inorganic nutrients needed by plants. Roughly, 90% of the dry matter in manure is organic waste material from animal digestion of feeds. The microbial population of animal waste is composed mainly of bacteria, fungi, actinomycetes, and protozoa. Significant decomposition of manure may occur in the feedlot if allowed to remain there long enough. Further decomposition occurs when applied to the soil. Manure should be plowed under to minimize N loss. Huge quantities of animal waste applied to the land may result in accumulation of some organic and inorganic constituents in concentrations that may become toxic to plants, particularly under anaerobic decomposition conditions.
(Christenbury-Iowa State)

## 0401-A6,B2,B3,D3,B2

### MANURE TRANSFORMATIONS AND FATE OF DECOMPOSITION PRODUCTS IN WATER,

Kansas Univ., Lawrence. Dept. of Civil Engineering.
Ross E. McKinney.
In: Agricultural Practices and Water Quality, 1970, Iowa State University Press, p 256-264. 15 ref.

Descriptors: *Anaerobic conditions, *Aerobic conditions, *Lagoons, Farm wastes, Odor, Aqueous solutions, Disposal, Microorganisms, . Design criteria, Water pollution sources, Waste water treatment.
Identifiers: Oxidation ditch, Anaerobic lagoons, Aerated lagoons, Oxidation ponds.

With regard to aqueous treatment systems for animal manure, it is apparent that aqueous treatment systems are not desirable for animal waste except in special situations. The concentrated animal wastes are not normally mixed with water and can be handled best as solid wastes. Chicken houses have been designed to handle the waste as solids. However, confined hog houses have too much fluid manure for handling as solids. The oxidation ditch has proven satisfactory for handling hog waste. Treated hog manure must be returned to the soil for final disposal. The soil is the ultimate acceptor of all animal wastes. There is no reason that the oxidation ditch should not be satisfactory for treating cattle manure. The biological treatment will reduce only a small fraction of the total solids of the manure. This treatment destroys the obnoxious qualities and results in a material that is more satisfactory for disposal.
(Christenbury-Iowa State)

## 0402-A4, A5, A11, A12, C3, F4

### DISEASE TRANSMISSION OF WATER-BORNE ORGANISMS OF ANIMAL ORIGIN,

Minnesota Univ., St. Paul. Dept. of Veterinary Microbiology and Public Health.
Stanley L. Diesch.
In: Agricultural Practices and Water Quality, 1970, Iowa State University Press, p 265-285. 93 ref.

Descriptors: *Diseases, *Animal diseases, *Animal pathology, *Human diseases, Farm wastes, Pathogenic bacteria, Pathogenic fungi, Pathology, Viruses, Water transfer, Human pathology, Parasitism, Water pollution sources.
Identifiers: Disease transmission, Rickettsia.

An effort is made to indicate the potential epidemiologic significance based on the variability of the resistant characteristics of various kinds of pathogenic organisms and their potential for water transmission. The historical implication of water and disease is briefly reviewed. The current problems of disease transmission related to water is discussed. To document water's role as a vehicle in disease transmission, information gathered from a literature review was used. Specific disease entities are grouped by classification based on etiology of the causative organisms. Infectious diseases of animals and man caused by bacteria, Rickettsia, viruses, fungi, and parasitic organisms are discussed. (Christenbury-Iowa State)

## 0403-B2, B3, B4, D1, D2, D3, E2

### ANIMAL WASTE MANAGEMENT TO MINIMIZE POLLUTION,

Minnesota Univ., Minneapolis. Dept. of Agricultural Engineering.
J. A. Moore.
In: Agricultural Practices and Water Quality, 1970, Iowa State University Press, p 286-297. 35 ref.

Descriptors: *Farm wastes, *Management, Aerobic conditions, Anaerobic conditions, Disposal, Tertiary treatment, Pollutants, Liquid wastes, Lagoons, Sedimentation, Trickling filters, Water pollution sources, Waste water treatment.
Identifiers: Flushing gutters, Composting, Aerated lagoons, Oxidation ponds, Slatted floors, Screening.

Management of animal waste can be broken down into four separate functions: collection, storage, treatment, and utilization or disposal. The options available for each of these functions are described. Collection is divided into two types: wet or dry. The remaining management functions depend on the collection type used. Three basic treatment processes developed by the Civil Service Engineers that apply to animal manure are described. These

are: Primary treatment, Secondary treatment, and Tertiary treatment. Almost all of the utilization and disposal of animal manures will be through land application. The disposal systems that have been proven are presented. These include liquid manure disposal as well as solid manure disposal.
(Christenbury-Iowa State)

## 0404-A5, A9, E2

### MOVEMENT OF AGRICULTURAL POLLUTANTS WITH GROUNDWATER,

Geological Survey, Raleigh, N.C.
Harry E. LeGrand.
In: Agricultural Practices and Water Quality, Iowa State University Press, Ames, 1970, p 303-313. 2 fig, 18 ref.

Descriptors: *Path of pollutants, *Farm wastes, *Water pollution sources, *Groundwater, *Agricultural chemicals, Fertilizers, Pesticides, Nutrients, Soil water, Soils, Seepage, Soil chemistry, Absorption, Soil mechanics, Water quality, Soil properties, Water wells, Water table, Environmental effects, Water chemistry, Infiltration.
Identifiers: *Agricultural pollutants.

The volume of groundwater polluted by plant nutrients, animal wastes, and pesticides appears to be small. Numerous small polluted zones of water occur in the upper part of the zone of saturation. Sufficient safeguards are available to minimize groundwater pollution to the extent that good agricultural practices should not be deterred. The unsaturated zone above the water table attenuates almost all of the foreign bodies that are potential pollutants of the underlying groundwater. Chemical fertilizers, animal wastes, and pesticides vary greatly in their tendency to degrade in ground environments. The following favorable environmental factors tend to reduce the changes of pollution of water from wells and springs: (1) A deep water table, which (a) allows for sorption of pollutants on earth materials, (b) slows subsurface movement of pollutants, and (c) facilitates oxidation or other beneficial 'die-away' effects. (2) Sufficient clay in the path of pollutants so that retention or sorption of pollutants is favorable. (3) A gradient of the water table beneath a waste site away from nearby wells. (4) A great distance between wells and wastes. (Woodard-USGS)

## 0405-A2, A3, A4, A5, A8

### EFFECTS OF AGRICULTURAL POLLUTION ON EUTROPHICATION,

Wisconsin Univ., Madison. Dept. of Sanitary Engineering, and Wisconsin Univ., Madison. Dept. of Water Chemistry.
D. E. Armstrong, and G. A. Rohlich.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 23, p 314-330. 14 tab, 2 fig, 26 ref.

Descriptors: *Eutrophication, *Nitrogen, *Phosphorus, Nutrients, Algae, Nitrates, Surface runoff, Base flow, Percolation, Leaching, Drainage, Farm wastes, Soil management, groundwater, Wisconsin, Water supply.
Identifiers: *Agricultural drainage, Lake metabolism, Mobility, Particulate form, Feedlots, Nutrient sources.

The paper discusses nitrogen and phosphorus transport in agricultural drainage since these are the most important nturients involved in eutrophication. It is generally expected that inorganic nitrogen is transported mainly as nitrate by percolating water, although the amounts of ammonium and nitrate carried in runoff waters may be highly significant in terms of the receiving water. Similarly, the largest amount of phosphorus is likely transported in particulate form in runoff waters, but the amount of dissolved phosphorus in runoff water may be of equal or greater importance even though lower in quantity. The contribution of agricultural drainage to the nitrogen and phosphorus status of waters is next examined. The data presented suggest that agricultural land is an important contributor of nitrogen and phosphorus to water. About 60% of the nitrogen and 42% of the phosphorus were estimated to come from agricultural land. Nutrient budget estimations were based on data obtained on a small scale and extrapolated and thus have a low reliability. Nutrient sources are numerous and generalizations as to which source is the most important cannot be made. The contribution of agriculture should be reduced by improved and more efficient agricultural management practices. (White-Iowa State)

## 0406-A4, A9, A12, B1, C2, F2

### EFFECTS OF AGRICULTURAL POLLUTANTS ON RECREATIONAL USES OF SURFACE WATERS,

Missouri Univ., Columbia. Dept. of Zoology; and Missouri Dept. of Conservation, Columbia.
Robert S. Campbell, and James R. Whitley.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 24, p 331-343. 3 tab, 1 fig, 43 ref.

Descriptors: *Pollutants, *Recreation, Lakes, Streams, Algae, Pesticides, DDT, Return flow, Sediments, Soil erosion, Fertilizers, Farm wastes, Fish, Fish eggs, Turbidity, Nutrients, Dissolved oxygen, Nitrogen, Phosphorus, Water Quality Act, Water quality.

Unquestionably many agricultural pollutants affect recreation through alteration of water quality and degradation of fish and aquatic life. The more serious polluting agents are eroded soil, agricultural fertilizers, animal wastes, and pesticides. While the problems relating to agricultural pollution are complex, and the solutions will not easily be attained, it seems reasonable that in many instances alternative procedures can be developed. Pollution control measures are available which will allow continuation of agricultural production and enhance and protect water quality and recreation. While these procedures may be costly to apply, the expenditure should be judged in light of its contribution toward the preservation of man's environment. Especially in the instance of pesticide use, protection of water quality may be requisite to protection of the health of man from unknown long-term effects of pesticides. Reduction and control of agricultural pollutants are essential to develop and maintain a high quality environment. Quality of life and quality of environment are synonymous.
(White-Iowa State)

## 0407-A3, D1, D3

### EFFECTS OF SURFACE RUNOFF ON THE FEASIBILITY OF MUNICIPAL ADVANCED WASTE TREATMENT,

Iowa State Univ., Ames. Dept. of Civil Engineering.
Robert E. Baumann, and Sheldon Kelman.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 25, p 344-362. 7 fig, 1 tab, 19 ref.

Descriptors: *Surface runoff, *Sewage treatment, Tertiary treatment, Biochemical oxygen demand, Industrial wastes, Farm wastes, Pollutants, Fertilizers, Nitrogen, Nitrates, Phosphorus, Phosphates, Algae, Eutrophication, Water quality, Rivers, Iowa, Corn, Discharge, Chlorophyll.
Identifiers: Industrial water pollution, Des Moines River, Packing plants.

The protection of the quality of water in Iowa streams requires that attention be directed at the various contributors of the significant pollutants. Attention is currently being directed at municipal and industrial wastes discharges, since these enter streams through a point source and are easily controlled. All such wastes must be given secondary treatment prior to discharge to Iowa's streams. As more stringent treatment requirements are demanded in the future, there is some question as to whether nutrient removals from municipal and industrial wastes will be sufficient to protect the stream. This study indicated that during periods of dry weather when light and turbidity conditions are favorable for phytoplankton growth, the principal source of the N and P required to support such growth is derived from municipal and industrial waste water discharges. Removal of N and P from such waste water discharges will help reduce phytoplankton growth. In periods of high stream flow, when turbidity levels are high enough to be unfavorable to phytoplankton growth, runoff from urban and rural lands and channel erosion are probably the principal contributors of N and P to the stream. Removal of N and P from municipal and industrial wastes during these periods will not reduce nutrient levels significantly. Under the latter conditions, tertiary treatment of municipal and industrial wastes will be of less benefit until runoff contributions of N and P are also controlled.
(White-Iowa State)

## 0408-A3, A4, A5, A9, F2

### LEGAL ASPECTS,

Iowa Univ., Iowa City. Coll. of Law.
N. William Hines.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 26, p 365-376. 26 ref.

Descriptors: *Legal aspects, *Water pollution, Farm wastes, Pesticides, Sediments, Fertilizers, Riparian rights, DDT, Water quality, Regulation, Water Quality Act, Standards, Administrative agencies, Pesticide residues, Soil erosion, Silting.
Identifiers: *Point sources, Common law, Nuisance, Feedlots, Registration.

The forec of the law has not been brought to bear on agriculture as it has on other major sources of water pollution. Agricultural pollution has thus far been ignored because it is less visible and more difficult to correct than are wrstes from municipalities and industry. Currently only those types of agricultural pollution that are obvious and subject to direct control receive legal attention. As point sources are brought under control, agriculture's more subtle contributions to water pollution will attract regulatory concern. Public regulation of agricultural pollution will take two primary forms: (1) direct restrictions on the use of chemical inputs to agricultural production, and (2) regulation of land use patterns and practices. Examples of the first type of regulation are prohibitions or limitations on the use of certain chemical biocides, fertilizers, and other additives. Land use regulations seem very likely to be necessary to effect a meaningful reduction in soil erosion. The ideal construct might involve the employment of land-use controls by a comprehensive watershed management authority. If this does not come to pass, exercise of such powers by other local districts such as soil conservation districts, conservancy districts, or drainage districts would be feasible, as would granting similar powers to the local pollution control agency. (White-Iowa State)

## 0409-A4, A5, E1, E2

### ECONOMIC ASPECTS,

Iowa State Univ., Ames. Dept. of Economics.
John F. Timmons.
Journal Paper No J-6469 of the Iowa Agricultural and Home Economics Experiment Station, Iowa State University, Ames, Iowa. Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 27, p 377-389. 9 ref.

Descriptors: *Water quality, *Economics, Management, Water quality control, Water resources, Costs, Benefits, Standards, Measurement, Water

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Quality Act.
Identifiers: *Quality levels, *Water supplies quality, *Water demand quality, Least cost method, Externalities, Public intervention, Water quality management, Quality use.

The first step toward meeting water quality management relating to water use within agriculture is being taken through becoming aware of the importance of water quality problems. The need to recognize the quality heterogeneities of water from demand and supply orientations is evident. The importance of demand orientations and requirements is paramount in specifying quality standards which vary among uses, spatially and temporally. Supply qualities must be geared to qualities demanded by uses. Least-cost methods are necessary in meeting demand qualities. In assigning benefits and costs to water uses, the problems of externalities, measurement, and intervention are crucial. Economics with its legacy of methods, theory, and its corps of resource economists is a necessary part of the multidisciplinary approach in planning and in carrying out relevant research necessary for education, legislation, and administration of water quality management. (White-Iowa State)

### 0410-A2, A4, A5, C3, F3

**ALLIANCE FOR ACTION,**
Federal Water Pollution Control Administration, Kansas City, Mo. Missouri Basin Region.
John M. Rademacher.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 28, p 390-396. 10 ref.

Descriptors: *Farm wastes, *Water pollution, Agriculture, Fishkills, Pesticides, Sediments, Runoff, Regulation, Zoning, Management, Waste treatment, Dissolved oxygen.
Identifiers: *Feedlots, *Technical base, *Inventory, Registration, Feedlot runoff, Animal waste management, Quantities, Runoff strength, Population equivalent.

The author chooses to look at animal wastes since this pollutant lends itself to more classical solutions than do other agricultural pollutants. He then pieces together the various interests involved with the animal waste problem. A technical base of information is required to establish effective controls. The development of an inventory noting animal production, concentration and location is an essential element of the technical base for the animal waste problem. Specific research and development needs must be delineated in accordance with the expected trends of the feedlot industry. Regulations are needed to ensure feedlot operators that measures they employ will guarantee a reasonable tenure of operation. Zoning regulations may be necessary and desirable. Mandatory registration should be an integral part of feedlot regulations. A sound animal waste management program encompasses prevention, reduction, treatment, and disposal of animal wastes. No one treatment process or system will be the solution for all animal production units. A variety of management and treatment systems will have to be developed. If it is the public who must bear the cost, then agriculture must have the courage to include waste treatment as a part of its production costs.
(White-Iowa State)

### 0411-A2, A3, A4, A5, A9, F2, F3, F6

**ACCOMPLISHMENTS AND GOALS,**
Federal Water Pollution Control Administration, Washington, D.C. Agricultural and Marine Pollution Control.
Harold Bernard.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970. Chapter 29, p 397-407. 2 fig, 1 tab, 2 ref.

Descriptors: *Water pollution, *Water quality, *Standards, Environment, Research and development, Management, Water Quality Act, Nebraska, Water supply, Water utilization, Water sports, Pollution abatement, Biochemical oxygen demand, Sewage treatment, Farm wastes, Nutrients, Return flow, Expenditures.
Identifiers: *Federal Water Pollution Control Administration, Agricultural pollution.

The article gives information as to the scope and extent of FWPCA activities relating to the control of agricultural pollution. Over $4 million has been expended in 1969 and 1970 on research and demonstrations involving pollution abatement from pesticides, nutrient runoff, irrigation return flows and feedlot operations. An example of criteria for water quality standards is given. Recommendations from a recent task force of seven cognizant Federal agencies studying the agricultural pollution problem are given. Data is presented indicating the need for municipal, industrial and agricultural pollution control. New techniques and systems must be developed to increase the quantity of pollutants removed from those sources before it reaches our streams. (White-Iowa State)

### 0412-A8, E2

**THE INFLUENCE OF ASHED POULTRY MANURE ON SOIL, SNAP BEANS, AND TOMATOES,**
Pennsylvania State Univ., College Park. Agricultural Experiment Station.
Charles A. McClurg, Ernest L. Bergman, and
Glenn O. Bressler.
Progress Report 312, April 1971, 9 p, 12 tab., 18 ref.

Descriptors: *Poultry, *Crop response, Farm wastes, *Waste treatment, Fertilizers, Soil analysis, Laboratory tests, Sampling.
Identifiers: *Ashed poultry manure, Waste reuse.

Four experiments were conducted to determine the growth of snap beans (phaseolus vulgaris L.) and tomatoes (lycopersicon esculentum mill) in a Hagerstown clay loam soil containing various proportions of ground dried and/or ashed poultry manure. Addition of ash significantly increased soil pH, available P, and milliequivalents and percent saturation of K, Mg, Ca in the soil. Germination of bean seed in pot culture was severely restricted by the amounts of ash and/or dried manure added to the soil due to excessive concentrations of soluble salts, however, pod yield increased with low levels of ash and dried manure. Leaf analyses indicated increased K and Mg and decreased Ca content when ash had been added to the soil. Addition of dried manure resulted in increased foliar content of P, K, Ca, Mg, Mn, Fe, and Al. There was no significant reduction of stand or yield when snap beans were grown under field conditions on soil to which 30t/acre ash had been added although maturity of pods appeared to be slightly delayed. Foliar analysis of beans grown in soil treated with ash showed significant increases of K, Mg, B, Na in leaves, while Ca and Mn decreased significantly. Application of ash to field soils at a rate of 120t/acre resulted in the death of all tomato transplants and no weed growth. With 60t/acre a 45 percent morality and consequent reduction of yield were observed. Ashed poultry manure can definitely be used in crop production but only in conjunction with a soil test. (Hazen-Iowa State)

### 0413-A11, C2, D1, D2, E3

**VALUE OF PROCESSED POULTRY WASTE AS A FEED FOR RUMINANTS,**
Pennsylvania State Univ., University Park.
F. F. El-Sabban, J. W. Bratzler, T. A. Long, D. E.
H. Frear, and R. F. Gentry.
Journal of Animals Science, Vol 31, 1970, p 107-111. 5 tab, 16 ref.

Descriptors: *Ruminants, *Poultry, *Digestion, *Diets, Farm wastes, *Waste treatment, Nitrogen, Animal metabolism, Livestock, Laboratory tests.
Identifiers: Waste processing, Waste utilization, Heat treated poultry waste.

Heat treated poultry waste was evaluated as a source of nitrogen for ruminant animals. Poultry waste was subjected to three different heat treatments to produce autoclaved (APW), cooked (CPW), and dried (DPW) products. In a sheep metabolism trial, wethers were fed semi-purified rations in which nitrogen was supplied by APW, CPW, or Soybean meal. Digestibility coefficients for dry matter and energy were not significantly different among rations, but that of protein was significantly higher for the ration containing soybean meal (control) than of the ration containing APW. Urinary energy was significantly higher for the control ration than for the rations containing APW or CPW. Fecal nitrogen was significantly lower for the control ration than for the rations containing poultry waste products, no other significant differences were found. Twenty-five angus steers, divided into four groups, were used in a 134-day feeding trial, steers were fed finishing rations in which all supplemental nitrogen was provided by soybean meal, APW, DPW, or urea. Rate of gain and feed rations in which supplemental protein was provided by soybean meal, APW or DPW. Rate of gain was significantly higher for steers fed a ration containing urea than those fed the ration containing DPW. Carcass characteristics and meat acceptability were not significantly different among steers fed the different rations. Chlorinated hydrocarbon compounds in backfat and liver arsenic were found in amounts less than 1 PPM. (Hazen-Iowa State)

### 0414-A2, A4, A5, A6, A7, F1

**THE POLLUTION POTENTIAL OF CATTLE FEEDING OPERATIONS,**
Investigations Leader, Northern Plains Branch, Fort Collins, Colorado.
F. G. Viets.
Montana State University Symposium on Agriculturally Related Pollution, February 10, 1970, Bozeman, Montana, pp. 11-16, 1 tab., 3 ref.

Descriptors: *Farm wastes, confinement pens, cattle, feedlots, groundwaters, odors, ammonia, dust, nitrates, air pollution, phosphorus, microbial,

The concentration of a large number of cattle into a very small space has created our problems of offensive odors in the air, runoff capable of polluting streams and killing fish, percolation of water to the water table making it hazardous to drink, and mountains of manure. Per capita beef consumption in the United States has increased about 3.5% a year over the last 20 years. At present, about 16 million cattle are fed annually. The pollution from runoff is an enormous problem in humid areas. The writer feels that adequate and economical solutions are not in sight, and that the economics of pollution control may force the cattle feeding industry into drier areas, even if grain must be hauled from the wetter grain producing areas. Air pollution from cattle feedlots includes odors, dust, and ammonia. Of these, only dust is being controlled to any great extent. Dust can be controlled to some degree by sprinklers. As to deep percolation, very little is known. However, nitrates in groundwaters in Missouri have been attributed to corrals. Other instances where wells are located close to feedlots, the water from the wells are unsuitable for drinking. It cannot be said that feedlots are polluting the water table with nitrates; however, the water under feedlots had an offensive odor and was enriched in ammonium and soluble organic and phosphorus compounds. (Bandy - ISU).

### 0415-A6, B3, B4, D1, E3

**TURNING WASTES INTO PROFITS,**
Earl D. Anderson.
Farm Quarterly, Vol 25, No 6, Nov-Dec 1970, p 48-85. 1 fig.

Descriptors: *Waste treatment, *Drying, Poultry, Odor, Waste storage.

Identifiers: Waste drying pit, Odor control, *Waste reuse.

The manure drying pit is a new concept in on-farm conversion of wastes to salable products. In the pit, circulating fans subject droppings to a continuous flow of drying air at an average velocity of 500 feet per minute. Also, the accumulated droppings are stirred and exposed to the drying air by a winch-drawn spike-toot- harrow. Periodically, the droppings are removed by means of a hinged cleanout board attached to the harrow. The partically dried manure can be stored indefinitely without developing an odor and without taking up moisture from the surrounding air. Controlling odors in the house provides a better environment for the birds and the attendants. (Hazen-Iowa State)

## 0416-A8, A11, A12, B2, C1, C3, E2

### A STUDY OF SOME DISEASE HAZARDS WHICH COULD BE ASSOCIATED WITH THE SYSTEM OF APPLYING CATTLE SLURRY PASTURE,

Agricultural Research Council, Compton (England). Inst. for Research on Animal Diseases.
J. Deans Rankin, and R. J. Taylor.
The Veterinary Record, Vol 85, November 22, 1969, p 578-581. 3 tab, 7 ref.

Descriptors: *Farm wastes, *Soil-borne diseases, *Slurries, Dairy cows, Waste water disposal, Soil contamination, Water pollution sources, Public health, Pollutant identification.
Identifiers: Bacterial survival.

Physical and bacteriological examinations of 16 samples of cattle 'slurry' have been carried out. On three occasions potentially pathogenic bacteria were isolated, namely, one strain of Salmonella dublin and two strains of haemolytic Escherichia coli. Five strains of potentially pathogenic bacteria survived for 11 to 12 weeks in slurry, although none of them appeared to multiply. The system of slurry disposal on pasture and its implications are discussed. (Hazen-Iowa State)

## 0417-A3, A4, A8, C2, E2

### ACCUMULATION OF PHOSPHATES IN WATER,

Agricultural Research Service, Morris, Minn. North Central Soil Conservation Research Center.
Robert F. Holt, Donald R. Timmons, and Joseph J. Latterell.
Journal of Agriculture and Food Chemistry, Vol 18, No 5, p 781-784, 1970. 1 tab, 37 ref.
Descriptors: *Phosphates, *Path of pollutants, *Eutrophication, *Leaching nutrients, Fertilizers, Precipitation (Atmospheric), Runoff, Animal wastes, Surface waters, Soil erosion, Nutrients, Algae, Lake Superior, Water Pollution sources, Minnesota, Washington, Connecticut.
Identifiers: Illinois River, St. Louis River, Black River (Minnesota), Lake Washington (Washington), Linsley Pond (Connecticut), Lake Zoar (Connecticut), Lake Minnetonka (Minnesota), Big Stone Lake (Minnesota), Lake Crystal (Minnesota).

Natural and agricultural sources of phosphorus to surface waters include percipitation, animal wastes, fertilizers, and land runoff. The actual contribution from these sources is shown to be quite low. However, the concentration of phosphorus required to support profuse algal blooms is so low that the limited amounts supplied are sufficient to exceed this requirement. Eroded soil delivers appreciable amounts of phosphorus to surface waters, but the soil materials capacity to sorb phosphorus results in little tendency for release of this source into the water. Bottom sediments appear to be a sink for dissolved orthophosphate that is supplied to surface waters. Leaching of vegetation can supply relatively large amounts of phosphorus to lakes and streams. Deep incorporation of phosphatic fertilizers materially reduces the concentration of phosphorus in runoff waters as compared to shallow incorporation. Phosphorus concentrations in several lakes and streams are shown. (McCann-Battelle)

## 0418-A11, C2, D2, E3,

### ENRICHMENT OF CATTLE MANURE FOR FEED BY ANAEROBIC FERMENTATION,

Auburn University.
J. D. Moore, W. B. Anthony.
Journal of Animal Science, Vol. 30, 1970, pp. 324.

Descriptors: *Waste Identification, Farm wastes, Cattle, Toxicity, Amino Acios, Feeds, Proteins, nitrogen.
Identifiers: *Organic Acid Synthesis, Toxicity trials.

It was determined that by fermenting cattle manure under anaerobic conditions organic acid synthesis occurred and the pH of the fresh manure dropped from 6.25 within 16-½ hours when incubated at 37°C. By adjusting pH with ammonia once every 24 hours for 3 days, the apparent crude protein level as determined by Kjeldahl Nitrogen analysis, increased from 16.99% to 43.26%. There was a net increase in amine acids greater than 20%. Organic acids (%DM) were acetic acid, 7.20; propionic acid 1:27; butyric acid, 1.34%, valeric acid, 0.11; and eactic acid, 16.83%. From palatability tests with lambs, rations containing either manure or ammonium lactate were equal. In toxicity trials using sheep, ammonium acetate was more toxic than urea. Dosages were made isonitrogenous with urea at the level of 0.88 urea/kg body weight, (Hazen - ISU).

## 0419-D3

### DIGESTION OF POULTRY MANURE BY DIPTERA,

Colorado State University, Department of Avian Science, Fort Collins.
B. F. Miller, J. H. Shaw.
Poultry Science, Vol. 48, No. 5, pp. 1844-1845, 1969.

Descriptors: *Diptera, Farm wastes, Poultry, Waste treatment, Waste disposal.
Identifiers: *Musca domestic, Muscina Stabulans.

Five species of Diptera were tested for their ability to properly grow, develop, and reproduce in fresh poultry manure. Musca domestica and Muscina stabulans were the two species found to be the most promising. Musca, with its high biological potential, effectively reduces poultry manure to a more stable product. This species will develop from egg to pupa in five to six days at 37°C. The larvae may be harvested by spreading the manure thinly on a screen under an intense light source. Because they are photonegative they will crawl through the screen permitting collection below. If they are permitted to develop to the pupa stage, the pupa can be separated from the manure residue by flotation. These larvae removed about 80% of the organic matter from fresh poultry manure in five to six days. The moisture content was reduced from 75 to 50% simultaneously. About 25 to 30 grams of larvae was produced from each kilogram of fresh poultry manure. (Hazen - ISU).

## 0420-A10, B2, C3

### SOME EFFECTS OF ORGANIC WASTES ON AQUATIC INSECTS IN IMPOUNDED HABITATS,

Louisiana State Univ., Baton Rouge. Dept. of Entomology., and Louisiana State Univ., Baton Rouge. Dept. of Microbiology.
C. D. Steelman, and A. R. Colmer.
Annals of the Entomological Society of America, Vol 63, No 2, p 397-400, 1970. 3 tab, 4 ref.

Descriptors: *Water pollution effects, *Organic wastes, *Aquatic insects, Habitats, Impounded waters, Coliforms, Mosquitoes, Lagoons, Indicators, Livestock, Water pollution sources.
Identifiers: Swine, Lagoon studies, Culex pipiens quinquefasciatus, Escherichia coli, Escherichia freundii, Escherichia intermedia, Aerobacter aerogenes, Coptotomus, Hydrous triangularis, Chironomus plumosus, Chaoborus, Brachydeutera, Musca domestica, Psychoda, Hermetia illucens, Stratiomys, Eristalis aeneus, Tabanus, Odonata.

The relative effects of organic waste pollution on the aquatic insect fauna of a freshly dug livestock waste disposal lagoon was studied. Introduction of organic waste material from swine pens into impounded aquatic habitat caused suppression of certain insect species. Decreases in aquatic insect fauna paralleled the increase in the organic waste concentration determined by changes in the numbers of coliform bacteria. The southern house mosquito, Culex pipiens quinquefasciatus Say, began laying eggs in the lagoon when coliform counts approximated 7000 organisms per milliliter of lagoon water. Water suspensions of pure cultures of coliforms Escherichia coli, E freundii, and E intermedia were found to be more attractive as oviposition sites for C p quinquefasciatus than water suspensions of Aerobacter aerogenes or sterile water. The change in insect fauna in the new lagoon during the 2-1/2 years' study was considered to be directly related to the change in the organic waste pollution of the water. The data obtained indicate the possibility of using aquatic insects as biological indicators of water quality. (Jones-Wisconsin)

## 0421-A8,E2

### EFFECTS OF MANURE APPLICATIONS AND MITE PREDATION ON CORN ROOTWORM POPULATIONS IN MINNESOTA,

Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.
H. C. Chiang.
Journal of Economic Entomology, Vol 64, No 3, June 1970, p 934-936. 3 tab, 4 ref.

Descriptors: *Mites, *Disposal, *Predation, Farm wastes, Laboratory tests, Soil treatment, Soil analysis, Soil tests, Population, Corn (Field), Distribution patterns, Water pollution effects.
Identifiers: *Corn rootworms, *Predaceous mites, Manure application, Soil test plots.

Manure was applied in corn plots in 1967 at the rate of 50 tons per acre. The northern and western corn rootworms, Diabrotica longicornia (Say), and D. virgifera LeConte, populations in these plots were reduced to about half the level of those in the check plots. Quantitative observations of the predaceous arthropods in the manured and the check plots showed that the total populations of ground beetles and spiders were not changed because of the manure application. However, the populations of mites, both predaceous and non-predaceous, were 3 or more times as high in the manured as in the check plots. On the basis of the vertical distribution of these mites and of corn rootworms, it was concluded that the predaceous mites could be feeding on corn rootworms. The data suggested that predation by mites accounted for a 19.7% control of corn rootworms under natural field conditions and a 63.0% control when manure was applied in the field. (Hazen-Iowa State)

## 0422-A11, C2, E3

### PROTEIN AND ENERGY VALUE OF PEANUT HULL AND WOOD SHAVING POULTRY LITTERS,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
Asok Nath Bhattacharya, and J. P. Fontenot.
Journal of Animal Science, Vol. 25, p 367-371, 1966, 5 tab, 20 ref.

Descriptors: *Feeds, *Peanuts, Diets, Animal metabolism, Digestion, *Farm wastes, Wood wastes, Proteins, Metabolism, Amino acids,

*Waste disposal.
Identifiers: Total digestible nutrient, Digestive coefficients, Hulls, Shavings, Litter, Chemical composition, Feeding trials.

Three digestion and metabolism trials were conducted with 10 yearling wethers to study the protein and energy value of autoclaved peanut hull and wood shaving broiler litters, when each was incorporated at levels of 25 and 50% in a corn-hay basal ration. Apparent digestibility of crude protein was not significantly different among rations. Crude fiber digestibility of the litter rations was higher ($P < .01$) than that of the control ration. Dry matter, NFE and energy digestibility were lower ($P < .01$) when the litter level in the ration was increased from 25 to 50%. (Hazen-Iowa State)

### 0423-A2, A4, A5, B1, B4, C2, E2, F1, F2

**2ND COMPENDIUM OF ANIMAL WASTE MANAGEMENT.**
Federal Water Pollution Control Administration, Kansas City, Mo. Missouri Basin Region.

June 1969. 256 p, 59 tab, 33 fig, 80 ref.

Descriptors: *Farm wastes, Rainfall-runoff relationships, Legislation, *Water quality, Pollutant identification, Disposal, Runoff, Grants, Cattle, Land use, Fertilizers, Management, Economics, Nutrients, Storage, Pollution abatement, Eutrophication, Design data, Erosion.
Identifiers: Feedlot wastes, Pollution potential, Nitrate movement, FWPCA, Population equivalents, Processing, Feedlot size, Feedlot runoff, Basin-wide planning.

Twelve papers were presented at the meeting. Major emphasis was placed on cattle feedlot pollution potential. Various aspects of the pollution caused by animal waste were discussed. Sources of pollutants and effects on water quality were emphasized. History and characteristics of animal waste pollution were discussed. Methods for minimizing pollution and the economics of disposal were considered. (Christenbury-Iowa State)

### 0424-A2, A4, A5, F2, F3, F4

**ANIMAL WASTE RUNOFF - A MAJOR WATER QUALITY CHALLENGE,**
Federal Water Pollution Control Administration, Kansas City, Mo.
A. V. Resnik, and Rademacher.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No 1. 21 p, 26 ref.

Descriptors: *Runoff, Farm waste, Legal aspects, Eutrophication, Groundwater, Water quality, Biochemical oxygen demand, Pollutant identification, Water pollution control.
Identifiers: Feedlot runoff, Population equivalents, Pollution potential.

An overview is presented of the causes and effects of animal waste pollution on water quality. The extent of the problem as well as the effects on surface and ground waters are illustrated with research data. The present status of legislation in regulatory control of pollution is discussed. Measures to strengthen present regulations are proposed.
(Christenbury-Iowa State)

### 0425-A2, A4, B1, C2

**ANIMAL WASTES–A MAJOR POLLUTION PROBLEM,**
Iowa Univ., Iowa City. Dept. of Civil Engineering.
R. R. Dagne.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No 2. 14 p.

Descriptors: *Farm wastes, Biochemical oxygen demand, Chemical oxygen demand, Hogs, Cattle, Iowa, Runoff, Disposal, Management, Rainfall-runoff relationships, Retention, Water pollution control.
Identifiers: *Livestock wastes, *Characteristics, *Feedlots runoff, Population equivalents, Swine, Site selection, Trends, Animal stocking rates.

The water pollution potential of livestock wastes is discussed. The characteristics of animal wastes are discussed. The major source of water pollution from livestock is open feedlots. The control fundamentals that apply to open feedlots are discussed. Feeding facilities must be designed and operated not only to optimize meat production but also to minimize pollution. (Christenbury-Iowa State)

### 0426-A4, A5, A6, A12, B1, C2, F2

**REGULATORY ASPECTS OF FEEDLOT WASTE MANAGEMENT,**
Kansas State Dept. of Health, Topeka. Environmental Health Services.
M. W. Gray.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No 3. 38 p, 14 tab.

Descriptors: *Legal aspects, Public health, *Legislation, *Fishkill, *Rainfall-runoff relationships, Farm wastes, Aquatic life, Water supply, Recreation, Management, Biochemical oxygen demand, Dissolved oxygen, Regulation, Cattle, Odor, Retention, Kansas, Water pollution control, Water pollution effects.
Identifiers: *Waste characteristics, *Feedlot runoff, Pollution potential, SHUD, Health aspects, Nuisances, Pollution control, Retention ponds.

The legal and environmental implications of pollution from cattle feedlots is discussed. A table is included that summarizes the fish kills that have been attributed to feedlot runoff in Kansas. Chapter 28, Article 18, of the Kansas State Board of Health Regulations is included. The author discusses methods for minimizing pollution of surface and groundwater from feedlots.
(Christenbury-Iowa State)

### 0427-A8, C2, E2, F1

**MANAGEMENT OF ANIMAL FEEDLOT WASTES – LAND SPREADING AS A DISPOSAL PROCESS,**
Missouri Univ., Columbia. Water Resources Research Center.
G. E. Smith.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No 4. 8 p.

Descriptors: *Management, *Farm waste, *Disposal, *Land use, Cattle, Fertilizers, Costs nutrients, Waste disposal, Water pollution control.
Identifiers: Nutrient removal, Application rate.

Disposal of animal waste onto land is effective and can increase crop yields. Attention must be given to the condition of the waste and supplemental nutrients added to insure a balanced fertilizer program. Cost of land disposal may exceed returns in terms of crop response, however land disposal can minimize animal waste disposal costs.
(Christenbury-Iowa State)

### 0428-A2, A4, B1, C2

**DESIGN FOR FEEDLOT WASTE MANAGEMENT - HISTORY AND CHARACTERISTICS,**
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
R. I. Lipper.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No 6. 9 p, 4 tab.

Descriptors: *Farm wastes, *Rainfall-runoff relations, *Pollution abatement, Biochemical oxygen demand, Runoff, Nutrients, Dissolved oxygen, Soil structure, Irrigation, Nitrogen, Detention reservoirs, Water pollution control.
Identifiers: *Feedlots, Pollution potential, Kjeldahl nitrogen.

The purpose is to illustrate the value of the cattle feeding industry to the state of Kansas; to relate its growth in the state to the emergence of a water pollution problem; and to make an attempt to describe the nature and magnitude of the problem in the best perspective that can be achieved at this time. Large-scale cattle feeding is a growth industry suited to Kansas resources and one that the state can ill afford to ignore. Efficient livestock production methods have given rise to water pollution problems. Pollutant concentration is approximately twice as great from a concrete lot as from an unsurfaced lot. Data is presented to evaluate the pollution potential of feedlot runoff.
(Christenbury-Iowa State)

### 0429-A3, A4, A5, C2, E2

**CONTRIBUTION OF FERTILIZERS TO WATER POLLUTION,**
Missouri Univ., Columbia. Water Resources Research Center.
G. E. Smith.
In: 2nd Conpendium of Animal Waste Management, June 1969, Paper No. 7, 16 p, 7 tab, 5 fig, 24 ref. PHS-FWPCA-USDI - WP00533.

Descriptors: *Eutrophication, Fertilizers, Farm wastes, Nutrients, Denitrification, Nitrification, Ammonification, Leaching, Erosion, Nitrogen, Runoff, Water pollution control, Groundwater, Septic tanks, Management.
Identifiers: *Methemoglobin, Nitrate movement, Feedlots, Residual accumulation, Soil cores.

Without chemical soil amendments the United States would be a food importing nation. Despite liberal fertilizer use, crops are removing more nitrogen and minerals than are being added in soil amendments. Many shallow wells in Missouri are contaminated with nitrates as a result of leaching from livestock feeding operations. The nitoate is not associated with losses from fertilized farm fields in most cases. There is little question that some of the nutrients applied in chemical fertilizers are moving into both surface and ground water; the percentage is thought to be relatively small. It is possible that nutrient losses may be less where good fertilization practices are followed than on unfertilized soils. (Iowa State)

### 0430-A2, B2, C2, F6

**CATTLE FEEDLOT WATER QUALITY HYDROLOGY,**
Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering.
T. E. Norton, and R. W. Hansen.
In: 2nd Conpendium of Animal Waste Management, June 1969, Paper No. 8, 26 p, 14 fig, 2 tab, 13 ref.

Descriptors: *Rainfall-Runoff relationships, *Liquid wastes, *Biochemical oxygen demand, Farm wastes, Dissolved solids, Hydrogen ion concentration, Alkalinity, Equipment, Simulated rainfall, Hydrology, Hydrographs, Rainfall intensity, Overland flow, Design data, Conductivity, Model studies, Water pollution control.
Identifiers: *Feedlot wastes, Pollution potential, Feedlots, Prediction method, Procedure.

Runoff wastewater from cattle feedlots is considered; the overall objective was to determine if the hydrology characteristics could be correlated with the quality characteristics through a modification of the flat plate model of overland flow. The results of the correlation could then be used to predict the quantity and quality of the runoff from existing feedlots. The data demonstrated the fact that the prediction method proposed requires extrapolation of data beyond the observed values. Therefore, additional information obtained from studies of runoff from full-scale feedlots would be advisable in determining the validity of this extrapolation. (Christenbury- ISU)

### 0431-A3, A4, A5, B1, F2

**MAJOR PROBLEMS OF WATER POLLUTION CREATED BY AGRICULTURAL PRACTICES,**
Federal Water Pollution Control Administration, Kansas City, Mo.
Walter F. Robohm.
In: 2nd Conpendium of Animal Waste Management, June 1969, Paper No. 9, 16 p.

Descriptors: *Farm wastes, *Erosion, *Water pollution sources, *Pollution abatement, Runoff, Pollutants, Sediment, Livestock, Legal aspects, Legislation, Sugar beets, Farm lagoons, Fertilizers, Salts, Irrigation, Ground water, Pollution identification, Tailwater, Water pollution effects, Water quality control.
Identifiers: *Population equivalents, Feedlots, Slaughter, Processing.

This paper discusses the magnitude of the water pollution abatement problem facing agriculture. The major acitivity which is contributing to water pollution is discussed. Sediment derived from land erosion constitutes by far the greatest mass of all the waste material arising from agriculture. The fundamentals of pollution of interest to agriculture are discussed. The control of pollution from agricultural sources is severly handicapped by lack of knowledge. It will take the combined efforts of engineers, waste treatment plant operators, city officials, agricultural people and citizens in general to solve the great national problem of water pollution. (IowaState)

### 0432-A4, A5, B1, C2, F2

**AGRICULTURE AS A SOURCE OF WATER POLLUTION,**
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
Eugene T. Jensen.
In: 2nd Conpendium of Animal Waste Management, June 1969, Paper No. 10, 11 p.

Descriptors: *Legislation, *Grants, Farm wastes, Nutrients, Sediment, Chemicals, Livestock, Water quality control, Pollution abatement, Federal Government, Disposal, Research and development.
Identifiers: *FWPCA, Basin-wide planning.

Various aspects of water pollution are discussed, including sources, types of pollutants, and methods of pollution abatement. The role that the Federal Water Pollution Control Administration plays in pollution control is discussed. Research grants and contracts are awarded to support basic and applied research projects relating to the causes control, and prevention of water pollution. The need for clean and usuable water demands that we build the cost of clean water into all our operations. (Iowa State)

### 0433-A2, A3, A4, A5, A9, B1

**EFFECT OF AGRICULTURE ON WATER QUALITY,**
Federal Water Pollution Control Administration, Evansville, Ind. Lower Ohio Basin Office.
T. R. Smith.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No. 11, 11 p, 9 ref.

Descriptors: Water quality control, *Nutrients, *Pesticides, Farm wastes, Silt, Erosion, Sedimentation, Runoff, Fertilizers, Nitrogen, Phosphorus, Algae, Livestock, Water pollution effects.
Identifiers: Feedlots, Wabash River Basin.

The main sources of agricultural associated water pollution in humid regions are: (1) silt from soil erosion; (2) fertilizers, mainly phosphorus and nitrogen compounds (3) pesticides; and (4) organic wastes from feedlots. In arid regions, irrigation return flows are a problem. This paper discusses the effect of each of these sources can have on water quality and suggests some preventative measures. It is necessary that agriculturalists plan to control pollutional effects on their activity. (Christenbury-ISU)

### 0434-A2, A5, A6, B2, E1, F1, F2

**ECONOMICS OF WATER POLLUTION CONTROL FOR CATTLE FEEDLOT OPERATIONS,**
Texas Tecnological Coll., Lubbock. Dept of Agricultural Economics.
T. R. Owens, and Wade L. Griffin.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No. 12, 62 p, 31 tab, 2 fig, 8 ref.

Descriptors: *Economic feasibility, Rainfall-runoff relationships, *Disposal, *Cost comparisons, Economics of Scalo, Farm wastes, Runoff, Design criteria, Legal aspects, Costs, Biochemical oxygen demand, Evaporation, Model studies, Hydrological data, Equipment, Detention reservoirs, Odor, Systems analysis, Groundwater, Seepage, *Water pollution control.
Identifiers: *Feedlot size, Playa lake disposal, Open field disposal, Overflows, Feedlot runoff.

The economic feasibility of various methods for controlling or disposing of feedlot runoff is determined. The various design criteria were applied to three different sizes of model feedlots: (1) 5000 head, (2) 10,000 head, and (3) 25,000 head. The approach to the problem of water pollution from feedlots used here involved control of runoff by establishing collection basins and subsequently discharging the runoff to one of two disposal areas or alternatively to hold the collected runoff until natural evaporation emptied the system. In general, evaporative discharge systems were considered inferior to their mechanical counterparts because of the lower degree of protection provided and the rather extensive land requirements for construction of the collection basin. (Iowa-State)

### 0435-A2, A3, A4, A5, A6, A7, A8, B2, B3, E2, F2

**THE MOUNTING PROBLEM OF CATTLE FEEDLOT POLLUTION,**
Frank G. Viets, Jr.
Agricultural Science Review, Vol 9, No 1, First Quarter 1971, p 1-8. 2 figs, 2 tab, 13 ref.

Descriptors: *Waste disposal, *Waste dumps, Farm wastes, Solid wastes, Air pollution, Runoff, Water pollution control.
Identifiers: *Feedlot pollution, Solid waste disposal, Soil pollution.

Steadily increasing demands for well-finished beef and the apparent profitability of large integrated feeding and slaughtering operations indicate that feed lots will grow larger and not smaller. Cattle feeding is moving from a small farm enterprise toward an agricultural industry. This results in a large concentration of wastes on a small area. Most large operators are making an effort to comply with water and air pollution regulations. Because stream and lake pollution from runoff is now prohibited, engineers are challenged to design facilities that minimize runoff or dispose of it economically and, hopefully, beneficially. Runoff control is much more difficult in humid climates than in drier ones. Underground water pollution appears to be mostly a local phenomenon. Most of the unsolved problems lie in the air pollution area. Offensive odor and their control still await thorough application of microbiological and chemical research. Manure can be disposed of and used as a resource if only a small portion of the land needed to produce the feed is available for manure disposal. Zoning appears to be one of the best solutions to the feedlot problem. (Hazen-Iowa State)

### 0436-A7, C2

**POULTRY DUST: ORIGIN AND COMPOSITION,**
Auburn Univ., Ala. Agricultural Experiment Station.
J. Koon, J. R. Howes, W. Grub. and C. A. Rollo.
Agricultural Engineering, Vol 44, No 11, November, 1963 p. 608-609. 4 fig.

Descriptors: *Dusts, *Farm wastes, Poultry, Environmental effects.
Identifiers: Environmental control, Dust composition.

Dust is a major problem in poultry environmental control as it impairs the operational efficiency of equipment to a degree that its use becomes impractical. A study was made to determine the composition of poultry dust and to establish the effects of temperature on the dust produced. Single comb H3W white Leghorn laying hens were exposed to constant temperatures of 50, 60, 70, 80, 90, 100F. Broiler tests were conducted using vantress male cross No. 50 arbor acres female Whiterock chicks. Qualitative and quantitative dust samples were obtained and tested. The dust from laying hens contained approximately 92% dry matter, of which 60% was crude protein. Fat analysis was 9%, cellulose 4%. The remainder of the dry matter was ash and hydrocarbons. The broiler dust was lower in fat and higher in protein. Birds raised on litter have a decline in dust production at 90F. Relative humidity for all environmental chambers was 60%. (Hazen-Iowa State)

### 0437-A5, A6, B1, C1, C2, E1, E2,

**PROPERTIES OF FARM ANIMAL EXCRETA,**
E. P. Taiganides, and T. E. Hazen.
ASAE Paper No. 64-315. Transactions of the american society of agricultural engineers, Vol. 9, p 374-376, 1966. 6 tab, 13 ref. Iowa Agricultural and Home Economics Experiment Station Project 1433.

Descriptors: *Farm wastes, *Physical properties, *Chemical properties, Biochemical oxygen demand, Chemical oxygen demand, Livestock, Disposal, Gases, Odor, Biodegradation, Fertilizers, Value, Nutrients, Pollutant identification.
Identifiers: Population equivalents, Handling.

Data on the most important of the physical, chemical, and biological properties of poultry swine and cattle excreta have been reported, analyzed and discussed as to their value in the design of manure treatment facilities. The distinction is made between sewage and manure. Feed influences the quantity of waste and its chemical composition. Little work has been done recently to determine the physical properties of animals wastes. The daily production of manure from farm animals varies considerably. The questions is raised if it pays to collect and use animals manures as fertilizer. The availability of manure handling devices and disposal problem of wastes indicates justification of application to soils. Poultry manure has highest fertilizer value, swine is next. The biochemical oxygen (BOD) test is used to determine pollutional strength of an organic waste in terms of the oxygen demand that the waste will exert on a water body if discharged into anatural watercourse in which aerobic conditions must be maintained. The chemical oxygen demand (COD) test is also used as an index of strength of waste. A comparison is made of BOD and COD production mean values for man, hens, swine, and cattle. There is a lack of information on the composition of the gases, and on the control of odors produced as a result of the uncontrolled biological degradation of manures. (Hazen-Iowa State)

### 0438-A8, E2

**SOIL CHEMICAL CHANGES AND INFILTRATION RATE REDUCTION UNDER SEWAGE SPREADING,**

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

R. E. Thomas, W. A. Schwartz, and T. W. Bendixen.

Soil Science Society of America Proceedings, Vol 30, 1966, p 641-646. 11 fig, 3 tab, 18 ref.

Descriptors: *Infiltration, *Lysimeters, Waste water treatment, Waste water disposal, Permeation, Chemical oxygen demand, Anaerobic conditions, Biochemical oxygen demand, Aerobic conditions, Disposal, Laboratory tests.
Identifiers: *Soil-pore clogging, Applied sewage effects, Microbial activity, Infiltration rate.

Laboratory and field lysimeters were used to investigate the site and nature of soil-pore clogging under sewage spreading. The site of clogging was located by determining with a seepage meter the impedance profile at 0.5-cm depth intervals. Soil samples were analyzed for sulfide, iron, phosphate, total organic matter, polysaccharide and polyuronide to evaluate possible causative relationships. The infiltration rate has exhibited three phases: Phase I, a slow reduction under aerobic conditions; Phase II, a rapid reduction under anaerobic conditions; and Phase III, a further gradual decline under anaerobic conditions. The primary site of clogging was the 0-1-cm depth of soil. Although sulfide was an indicator of anaerobic conditions it was not a primary cause of clogging. Accumulations of the other five measured constituents may contribute to clogging in both Phase I and Phase II. Organic matter was the only probable clogging agent to decline as the infiltration rate was partially recovered in a rest cycle. (Hazen-Iowa State)

### 0439-C2, C3, D3

**THE DECOMPOSITION OF URIC ACID IN BUILT UP POULTRY LITTER,**

Edinburgh Univ. (Scotland). School of Agriculture; and Edinburgh Univ. (Scotland). Dept. of Bacteriology.

Henrietta E. Schefferle.

Journal of Applied Bacteriology, Vol 28, No 3, 1965, p. 412-420. 1 tab, 6 ref.

Descriptors: *Farm wastes, *Decomposing organic matter, *Bacteria, Poultry, Aerobic bacteria, Nitrogen, Water pollution sources.
Identifiers: *Uric acid decomposition, Coryneform bacteria, Urease activity, Ammonia formation.

The decomposition of uric acid in built up poultry litter appears to be brought about almost exclusively by the action of aerobic bacteria. Organisms decomposing uric acid usually comprised about one quarter of the bacterial population. There were strains of coryne bacterium and less frequently strains of NOCARDIA, STREPTOMYCES, PSEUDOMONAS, ALCALIGENES, and ACHROMOBACTER. Uric acid was converted to ammonia by some of the organisms but only to urea by the majority. Hydrolysis of urea to ammonia could be brought about by strains of corynebacterium, Micrococcus, Alcaligines, Achromobacter, and cytophaga which had no action on uric acid. It is suggested that the ammoniacal smell and high alkalinity of built up poultry litter result largely from the decomposition of uric acid. The identity of the bacteria concerned is discussed. (Hazen-Iowa State)

### 0440-A4, A7, A13, E2, F2

**LEGAL ASPECTS PERTAINING TO ENVIRONMENTAL REGULATIONS IN PORK PRODUCTION,**

Missouri Univ., Columbia. Dept. of Agricultural Economics.

Donald R. Levi.

American Pork Congress - Proceedings, Environmental Quality Workshop, Des Moines, Iowa, Mar 3, 1971. p 103-111.

Descriptors: *Farm wastes, *Legal aspects, Water pollution, Air pollution, Public rights, Regulation, Judicial decisions, Damages, Zoning, Permits, Maintenance, Water pollution control.
Identifiers: Public regulation, Private regulation, Nuisances, Legal principles, Lawsuits, Liability, Actual damages, Punitive damages, Site selection.

Public and private regulation of both air and water pollution is provided by pollution boards or commissions and through nuisance laws. Two lawsuits are discussed so that the legal principles involved might help determine what courses of action will help avoid such situations. In a nuisance law case the complaining party may ask for (1) an injunction, (2) damages (either actual or punitive), or (3) both an injunction and damages. The nuisances involved may be either public or private. A plaintiff may have a better chance if the rights of the public are being affected. Methods of avoiding lawsuits include the use of zoning, site selection, licensing, proper maintenance, adequate facilities, and being a 'good neighbor.' (White-Iowa State)

### 0441-C2, F6

**METHODS OF SAMPLE PREPARATION FOR CHEMICAL DETERMINATION OF CHROMIC OXIDE IN BOVINE FECES,**

Kentucky Univ., Lexington. Dept. of Animal Science.

P. R. Utley, N. W. Bradley, and J. A. Boling.

Journal of Dairy Science, Vol 54, No 7, p 1091-1093, July 1971. 1 tab, 11 ref.

Descriptors: *Animal waste, *Chromium, *Nutrient, Chemical analysis, Laboratory, Indicators, Diurnal, Digestion, Statistical method, Time series analysis, Diet.
Identifiers: *Corn-urea diet, Blender, Chromium oxide, Feces, Fecal recovery, Ground corn.

Fecal samples were prepared by four different methods to observe the variation and per cent recovery of added chromic oxide with each method. Variation was greatest in the samples dried and ground with a Wiley mill and those homogenized and analyzed wet. The standard errors of the samples dried and ground with a hand grinder and those homogenized and analyzed dry were lower than those of the other two groups of samples. The average per cent recovery ranged from a low of 98.8% (homogenized, analyzed wet) to a high of 100.2% (homogenized, analyzed dry). The variation in chromic oxide concentration tended to be greater in samples containing the highest per cent moisture at time of analysis. (Bundy-Iowa State)

### 0442-A6, B2, C1, C2, C3, D2, F1

**CAN LIME AND CHLORINE SUPPRESS ODORS IN LIQUID HOG MANURE,**

Illinois Univ., Urbana. Dept. of Agricultural Engineering.

C. W. Hammond, D. L. Day, and E. L. Hansen.

Agricultural Engineering, Vol 49, No 6, p 340-343, June 1968. 4 fig, 8 tab.

Descriptors: *Lagoons, *Anaerobic bacteria, *Chlorination, *Hydrated lime, Sand filters, Mositure content, Biochemical oxidation demand, Chemical oxidation demand, Swine, Air circulation, Organic waste, Evaporation, Hydrogen ion concentration, Odor.
Identifiers: *Hog confinement building, Slatted floors, Experimental farm, Liquid hog manure.

Liquid manure collected in pits beneath self-cleaning slatted floors supports anaerobic bacteria that produce objectionable gases and odors in the hog confinement building. Studies were instituted to check the use of lime and chlorine for preventing the production of these odors. The studies indicated that hydrated lime reduced the production of hydrogen sulfide, but to a lesser extent than the chlorine. It did not prevent the liberation of ammonia. The hydrated lime required to maintain the desired pH would cost $0.62 per hog for 6 months at $2.20 per 100 lb. Chlorine treatment is an effective deterrent of ammonia, hydrogen sulfide, methane and carbon dioxide. The cost of adding enough chlorine to fill the chlorine demand is about $6.40 per hog for 6 months, based on a cost of $0.54 per gal. for the sodium hypochlorite. Chlorine and lime were also effective in controlling maggots and rodents in the building. Chlorine seemed most effective. Sand-bed filtering was also found effective in trapping solids and organic matter. Fewer than 5 per cent of the solids penetrated the sand to any significant depth, the largest portion being left on surface. (Brundy-Iowa State)

### 0443-A6, B2, C3, D3

**SULFUR BACTERIA IN RED LAGOONS,**

Nebraska State Dept. of Health, Lincoln. Div. of Environmental Engineering.

O. Sletten, and R. H. Singer.

Journal Water Pollution Control Federation, Vol 43, No 10, October 1971, p 2118-2122. 27 ref.

Descriptors: *Lagoons, *Sulfur bacteria, *Pigments, Oxidation lagoons, Farm wastes, Aerobic conditions, Anaerobic digestion, Anaerobic bacteria, Waste water treatment.
Identifiers: Red pigmentation, Thiorhodaceae.

Widespread investigations demonstrate that various genera of photosynthetic sulfur bacteria of the family Thiorhodaceae are usually responsible for red pigmentation in anaerobic waste stabilization lagoons. A number of these genera display only slight differences in morphology. Further taxonomic study may reveal that such differences represent nothing more than environmental reactions of a single genus. From observations and experience relating to the photosynthetic sulfur bacteria, the authors concur with other investigators on the possible practical role of these organisms in anaerobic waste lagoons. If the organisms are not naturally present in the lagoon, it has been recommended that they be introduced into it by massive inoculation. Their practical value lies in their potential ability to destroy reduced sulfur compounds and eliminate or reduce offensive odors. (Parker-Iowa State)

### 0444-A2, A4, A12, C3

**PROLONGED SALMONELLA CONTAMINATION OF A RECREATIONAL LAKE BY RUNOFF WATERS,**

Wisconsin Univ., Madison; Medical School. Wisconsin State Lab. Hygiene, Madison.

D. G. Claudon, D. I. Thompson, E. H. Christenson, G. W. Lawton, and E. C. Dick.

Applied Microbiology, May 1971, Vol 21, No 5, p 875-877. 2 tab, 11 ref.

Descriptors: *Salmonella, Water pollution sources, *Recreation facilities, Runoff, Lakes, Beaches, Sampling, Bacteria, Tributaries, Streams, Bayou, Sewage, Wisconsin.
Identifiers: *Lake Mendota, Contamination, Washwater, Moore swab, Madison (Wisc).

In the summer and fall of 1968 various Salmonella serotypes were isolated from a portion of Lake Mendota, the major recreational lake for Madison, Wisconsin. The apparent sources of these organisms were a residential storm sewer and a University of Wisconsin Experimental Farms' washwater drain. Salmonellae were isolated with regularity from a swimming beach located approximately 0.5 mile from these sources. (Parker-Iowa State)

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### 0445-A4, B2, E1, F2

**EFFLUENT DISPOSAL,**
Lactose Co. of New Zealand Ltd., Kapuni.
J. M. Wood.
New Zealand Journal of Dairy Technology, Vol 4, No 4, December 1969, p 238-242.

Descriptors: *Dairy industry, *Waste disposal, *Water pollution sources, Legislation, Administration, Organic wastes, Biochemical oxygen demand, Milk, Oxidation, Water pollution control, Water pollution, Water temperature, Dissolved oxygen.
Identifiers: *New Zealand, Water Pollution Act, Effluent, Disposal.

An increasing concern in the preservation of natural water resources, and their protection from pollution is appearing in New Zealand even though the problem has not reached serious proportions there. This author has reviewed the New Zealand legislation with respect to this problem, especially the Water and Soil Conservation Act of 1967. He also reviews some aspects of river pollution and its causes and effects. He finishes with a brief discussion of some effluent treatment and disposal methods, with particular reference to the dairy industry. (Parker-Iowa State)

### 0446-A1, B1, E2, E3, F1, F2

**BASIC POINTS TO CONSIDER IN MANURE DISPOSAL PROBLEMS,**
Richard D. Chumney.
Poultry Digest, December 1970, p 608.

Descriptors: *Farm wastes, *Poultry, *Waste disposal, Regulation, Costs, Environmental effects, Technology.
Identifiers: Recycling.

The greatest deterrent to future progress of the U.S. poultry industry is the lack of technological and managerial know-how for proper and efficient disposal of poultry waste. In approaching the problem the following points should be considered: (1) Regulatory enforcement should not exceed the present 'state of the art.' (2) The cost of waste disposal must be included as a regular cost of doing business. (3) New techniques for the recycling of poultry waste into the soil and as feed supplements is the best long range approach. (4) Every precaution must be taken to protect our total environment as we dispose of poultry waste. (Parker-Iowa State)

### 0447-A2,A4,A5,A6,A7,B1, C2,C3,D3,E2,E4,F4

**LIVESTOCK WASTES,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. R. Miner.
Journal Water Pollution Control Federation, Vol 43, No 6, June 1971, p 991-998. 60 ref.

Descriptors: *Farm wastes, *Waste disposal, *Reviews, Waste treatment, Publications, Gases, Odors, Soil disposal fields, Aerobic treatment, Aeration, *Reviews, Bibliographies.
Identifiers: *Livestock wastes, *Literature review, Feedlot runoff.

This is a review of the literature on research in the area of livestock waste management and its influence on water quality. Discussions include waste treatment systems, waste characteristics, manure handling systems, gases and odors, application of wastes to cropland and cattle feedlot wastes. A short review of sixty references in this area is given. (Parker-Iowa State)

### 0448-A6, C2, D3, E3

**INDIAN UTILIZES NOVEL MANURE DISPOSAL SYSTEM,**
Patel Poultry Farm, Boroda (India).
Jawahar D. Patel.
Poultry Digest, Vol 26, p 100-101, 1967.

Descriptors: *Farm wastes, *Methane, *Gases, *Anaerobic digestion, Fertilizers, Odor, Temperature, Disposal, Poultry, Fuels.
Identifiers: India, Working details.

An anaerobic digester that converts poultry manure into useful methane gas is being utilized in India. Poultry manure gives 1.5 to 2.0 cu. ft. of gas per pound in a short period of digestion and at a temperature of 35 degrees C. 35.3 cu. ft. of methane is equivalent to 2.2 kilowatt-hours of electrical energy. The digested manure is a valuable fertilizer because it supplies not only nutrients such as nitrogen, phosphorus, potash, iron, copper, cobalt, maganese, calcium, magnesium, etc., in a well-balanced proportion, but also most valuable humus to plants for successful crop production. (Christenbury-Iowa State)

### 0449-C1, C2, E2, E3, F1

**WASTES FROM THE POULTRY INDUSTRY,**
National Agricultural Advisory Service, Guildford (England).
C. T. Riley.
Agriculture, Vol 75, No 8, p 374-376, Aug 1968.

Descriptors: *Poultry, Reclamation, Waste disposal, Nitrogen, Fertilizer, Protein, Moisture.
Identifiers: *Refeeding wastes, Cage layers, Broilers, Deep litter, Recycling.

Some waste materials normally produced by the poultry industry are defined and their relative importance is indicated. The increasing volume of wastes produced and the economics of utilizing these poultry wastes are discussed. (Dorland-Iowa State)

### 0450-A5, A8, A12, C2, E2

**NITRATE AND SALT IN SOILS AND GROUND WATERS FROM LAND DISPOSAL OF DAIRY MANURE,**
D. C. Adriano, P. F. Pratt, and S. E. Bishop.
Soil Science Society American Proceedings, Vol. 35, 1971. p. 759-762, 3 fig, 3 tab, 14 ref.

Descriptors: *Farm wastes, *Water pollution sources, Groundwater, Salinity, Leaching, Nitrogen, Ammonia, Irrigation, Pastures, Lagoon, Application rate.
Identifiers: *Dairy wastes, Chino-Corona Basin, Feedlots, Well waters.

The NO3 - contents of soils and ground waters underneath lands used for disposal of manures from dairies in the Chino-Corona Basin were determined. Soil and water samples were taken from 15 holes drilled to the top of water table in sites representing corrals, irrigated croplands, and pastures used as disposal areas. Considerable amounts of NO3- and salt were found in soil profiles underneath the disposal areas, although the magnitude was not as high as in profiles under corrals. Average NO3- -N concentrations in waters sampled from water tables were 26, 57, 45, and 74 ppm for control (undisturbed), corral, cropland, and pasture sites, respectively, exceeding the PHS recommended limit of 10 ppm NO3- -N for safe drinking water. Domestic well waters pumped from deeper aquifers averaged 6 ppm of NO- -N. Contributions of NO3- -N to ground waters, as indicated by deep soil samples, on a per unit area basis, tended to be: corralSpastureScropland. Existing conditions in the study area need some modifications if acceptable quality of the ground waters is to be maintained. (Bundy-Iowa State)

### 0451-A4, A11, A12, B2, C3, D3, E1

**REDUCTION OF SALMONELLA IN COMPOST IN A HOG-FATTENING FARM OXIDATION VAT,**
E. H. Kampelmacher, and L. M. Jansen.
Journal Water Pollution Control Federation, Vol 43, No 7, July 1971, p 1541-1545. 4 fig, 3 tab, 3 ref.

Descriptors: *Farm westes, *Oxidation ponds, Fertilizer, Swine, Aerobic, Aeration, Bacteria, Effluent, *Salmonella, Samples, Confinement pens, *Waste water treatment.
Identifiers: Oxidation vats, Bacteria count, Hog-fattening farm, Aerobic flora.

In recent years the number of large hog-fattening farms, where frequently thousands of animals are fattened, has increased greatly. On these farms, the disposal of urine and feces, which in such large quantities can no longer be used for fertilization, constitutes a serious problem. In order to deal with it by means of purification, oxidation vats have been constructed and oxidation ditches dug on these farms. A description is given of experiments carried out with a small experimental oxidation vat suitable for 160 hogs and installed on a hog-fattening farm in Wageningen by the Institute Landbouw en Bedrijfsgebouwen. The study was performed to determine whether bacteriological reduction in general and elimination of Salmonella in particular occur. The reduction of Salmonella in composts in an experimental oxidation vat on a hog-fattening farm was shown to be approximately 100-fold. As long as the excretion of Salmonella in the feces of the hogs remain low, only small numbers of Salmonella bacteria will be sluiced out with the effluent, thus, the possibility of human and/or animal infection in surface water may be regarded as very slight. As soon as either the number of hogs or the number of excreted bacteria, or both, increases, the plant can no longer adequately reduce the number of salmonellae to the extent that the effluent can be sluiced out into open water without the danger of human or animal infection. Therefore, it is recommended that adequate chlorination of the effluent of such plants be considered. (Bundy-Iowa State)

### 0452-A5, A8, B1, C2

**GROUNDWATER CONTAMINATION,**
Guelph Univ. (Ontario). Dept. of Soil Science.
Robert W. Gillham, and L. R. Webber.
Water and Pollution Control, Vol 106, No 5, p 54-57, May 1968. 5 fig, 1 tab, 11 ref.

Descriptors: *Groundwater, *Piezometry, *Water table, *Surface-groundwater relationships, *Water pollution sources, Infiltration, Wastes, Hydraulic conductivity, Subsurface drainage, Transmissivity, Head loss, Darcys law, Time lag, Nitrogen compounds, Nitrates, Discharge measurement, Discharge (Water), On-site data collections, Underflow.
Identifiers: *Hydraulic potential, Canada.

All inorganic salts of N are very soluble in water and N in the nitrate form is particularly hazardous for both humans and livestock. Barnyards and feedlots may be prime sources of inorganic N in groundwater. A piezometric network was installed radially throughout a barnyard for determination of groundwater discharge out of the barnyard so that it could be correlated with the changes in the N concentration of the water as it passed beneath the barnyard. The active head of water in a given piezometer was measured at different times. Its basic time lag, together with the geometry of the piezometer, could be used to calculate hydraulic conductivities from a large number of sites. These were then used to construct a map of isopotential lines indicating changes in hydraulic potential with distance. A simplifying assumption was that hydraulic potential did not vary vertically in the water table to bedrock. Together with N measurements at various depths to bedrock, the results showed that the barnyard contributed 0.00189 lb N/hr to the groundwater, or about 17.5 lb N/yr. This was considered surprisingly low, since the manure of a single cow could produce 74 lb N/yr. (Casey-Arizona)

## 0453-A3, A4, A6, A7, A12, E1, F3

**PLANT NUTRIENTS AND WATER QUALITY,**
C. R. Frink.
Agricultural Science Review, Vol 9, No 2, Second Quarter 1971, p 11-25. 4 tab, 3 fig, 34 ref.

Descriptors: *Cycling nutrients, Water quality control, Fertilizers, *Nutrients, Watersheds (Basins), *Farm wastes, Surface runoff, Subsurface runoff, Systems analysis, Farm wastes, Nitrogen, Nitrates, Agricultural chemicals, Fertilizers, Phosphorus, Water pollution sources.
Identifiers: *Plant nutrients, Political units, Farming systems.

Nutrient yields to waterways were examined in three ways: direct measurements in watersheds, analysis of farming systems, and calculations for political subdivisions. Direct measurements in watersheds have shown, for example, that agricultural runoff supplied significant quantities of nitrogen in the Potomac River Basin but was not an important source of phosphorus. Farming systems analysis was proposed to avoid the cost of a national water monitoring network. Such things as various methods of fertilizer application were considered. And the possibility of sewage effluent to a soil-crop filter rather than dilution in streams. The calculations of nutrient sources for political units should help us establish priorities in the expensive process of providing clean water. We ought to direct our efforts towards minimizing nutrient yields from all significant sources, and ask how much stopping the yields will cost society. The author suggests that we abandon our preoccupation with obtaining the maximum yield per acre and consider instead a system analysis of agricultural practices that will maximize all benefits to society. (Parker-Iowa State)

## 0454-A1, F1, F2

**SOCIAL ASPECTS OF ENVIRONMENTAL POLLUTION,**
Oregon State Univ., Corvallis. Air Resources Center.
Robert M. Alexander.
Oregon Water Resources Research Institute, Corvallis, March 1971. 49 p, 31 ref. OWRR Project A-999-ORE (8).

Descriptors: *Social aspects, *Resource allocation, *Pollution abatement, *Industrial wastes, Environmental sanitation, Cost-benefit analysis, Marketing, Economics, Feasibility studies, Diseconomies of scale, Social values, Social change, Social needs, Pollutants, Water pollution, Air pollution, Pesticide toxicity, Radiation, Radioactivity effects, Waste disposal, Pollution abatement, Judicial decisions, Administrative agencies, Regulation, Permits.

The social aspects of environmental pollution resulting from scientific and technological changes in industry are examined. Specific side effects studied include air and water pollution, pesticide toxicity, and ionizing radiation. These are considered from several economic and political viewpoints. Social goals are broken down to determine the degree of pollution abatement possible in view of the costs involved. The extent to which society is willing to bear the cost of controlling industrial pollution, and who will bear these expenditures is analysed. The article examines the market mechanism, side effects, and external costs, concentrating upon the market mechanism and its role in allocating resources. Alternatives are suggested for dealing with the side effects of pollution: (1) the establishment and protection of rights by private negotiation, (2) adversary proceedings, measures to strengthen judicial proceedings, and courts as a political force in fostering environmental quality; (3) regulation by licensing and permit issuance; and (4) incentive programs based upon payments or charges. The article concludes with a reassessment of key social issues in relation to a reordering of priorities so as to favor environmental quality. (Rees-Florida)

## 0455-A2, A4, A6, A7, A12, E1, F3

**ANIMAL WASTE DISPOSAL BECOMES A MORE DIFFICULT PROBLEM,**
Illinois Univ., Urbana. Dairy Science.
S. L. Spahr.
Illinois Research, Vol 12, No 4, p 4-5, Fall 1970.

Descriptors: *Disposal, *Odor, Farm wastes, Runoff, Illinois, Equipment, Farm lagoons, Gases, Water pollution control, Storage pits, Waste treatment.
Identifiers: Feedlot runoff, Oxidation ditch, Pollution potential, Uses, Research needs.

Many of the current systems of animal waste disposal may create serious health and pollution problems. Little knowledge is available to solve many of the problems facing the livestock producers. Current technology and future research needs for waste disposal are discussed. (Christenbury-Iowa State)

## 0456-A6, B1, E2

**TRY TO KEEP ODORS UNDER CONTROL,**
J. L. Skinner.
Poultry Digest, March 1971. p 116.

Descriptors: *Odor, Farm wastes, Poultry, Livestock, Management, Disposal, Public rights, *Waste treatment.
Identifiers: *Odor control, Public relations.

Four suggestions are given for managing conditions related to odor problems: (1) Reduce spillage and overflow from watering systems. (2) Make sure that manure removal systems actually remove manure and do not leave unnecessary accumulations in corners, adjacent to winch and drive mechanisms, and around discharge elevators. (3) Use only manure transport vehicles that do not spill or leak on roadways. (4) Avoid field spreading manure near residences, close to roads, late in the afternoon of still days or on weekends. (Hazen-Iowa)

## 0457-A4, A5, B2, D3, E2, F2

**DISPOSAL OF LIQUID WASTES FROM PARLORS AND MILKHOUSES,**
Pennsylvania Agricultural Experiment Station, University Park.
N. H. Wooding.
Special Circular 154 (1971), 12 p, 2 tab.

Descriptors: *Farm wastes, *Aerobic treatment, *Sprinkler irrigation, Solid wastes, Effluents, Treatment facilities, Lagoons, Milk, Irrigation systems, Permits, Pennsylvania, Legislation, Septic tanks, Liquid wastes, *Dairy industry, Cattle, *Waste water treatment, *Waste water disposal.
Identifiers: *Dairy cattle, Milking parlor wastes, Pennsylvania Clean Streams Law.

The problem of disposing of liquid wastes from dairy operations is becoming increasingly important in the light of current legislation. The Pennsylvania Clean Streams Law and its effect upon this disposal are discussed. The Clean Streams Law requires a waste water disposal permit for any facility that will discharge into surface or underground waters, create a danger of polluting these waters, or may be necessary for effective regulation of the facility even though it does not have a direct discharge. One of the major problems of a dairy operation is the disposal of milking parlor liquid wastes. One method of treatment is the use of aerobic lagoons, anaerobic lagoons being unacceptable due to the production of odors. Solid wastes and milk should be excluded to prevent overloading the system. The wastewater from the lagoon can be disposed of with a sprinkler-irrigation system. (Dorland-Iowa State)

## 0458-A6, B2, B4, C2, E2

**USE OF SOIL TO TREAT ANAEROBIC LAGOON EFFLUENT: DESIGN AND OPERATION OF A FIELD DISPOSAL SYSTEM,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
Dale H. Vanderholm, and Craig E. Beer.
Transactions of the American Society of Agricultural Engineers, Vol 13, No 5, p 562-564, Sept-Oct 1970. 1 tab, 2 fig, 17 ref. OWRR Project A-021-IA (3).

Descriptors: *Farm wastes, *Disposal, *Anaerobic digestion, *Irrigation systems, Runoff, Farm lagoon, Livestock, Pollutants, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Odor, Storage capacity.
Identifiers: *Land requirements, Livestock wastes.

The study was initiated to investigate the pertinent variables involved and evaluate the performance of an irrigation system for the disposal of livestock waste. It was desired to determine irrigation rates, frequencies, and quantities that would result in satisfactory renovation of the lagoon effluent with no detrimental effects. The results indicate, that for waste-water irrigation, the tabulated rates for clear water are too high and should be reduced, possibly 30 to 50 percent. The average COD removal was 97 percent. Smaller applications made more frequently were the most efficient for COD reduction. 80 percent of the nitrogen is removed. 99 percent of the phosphates were removed. This method of waste disposal appears feasible. The results of the study indicate an optimum level for the observed soil and climatic conditions of about 2 in. of lagoon effluent per week during the growing season. (Christenbury-Iowa State)

## 0459-A11, B2, B4, E2

**LIQUID MANURE FOR MIDWEST SWINE PRODUCTION,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering. Liquid Manure for Midwest Swine Production,
D. G. Jedele.
Transactions of ASAE, Vol 2, No 1, 1959, p 9-10. 6 fig.

Descriptors: *Farm waste, *Swine, Septic tank, Sewage lagoons, Liquid waste, Irrigation, Confinement pens, Animal disease, Liquid wastes, Waste disposal.
Identifiers: *Tank wagon, *Spreaders, Storage tank, Material handling, Hand scraping.

With the trend of raising swine in confinement, renewed interest in liquid manure disposal is being created. The primary method used by Illinois swine producers is the collection of liquid manure in storage tanks, and then the disposal by tank wagon on crop land. The finishing floors are normally on slopes varying from 1/4 inch per foot to one inch per foot. The methods of cleaning floors range from hand scraping followed by water rinsing to high pressure water rinsing only. For hand scraping combined with rinsing about 1/4 gal. of water per hog is required. For high pressure rinsing about 1/2 gal. of water per hog is required. For computing capacities for storage tanks, a minimum of 2 gal. per hog per day is suggested. Up to this time most spreading equipment is homemade. The spreader used ranged from 6 ft. to 20 ft. spread per swath. (Bundy-Iowa State)

## 0460-A7, A11, B1, F1

**EFFECT OF TYPE OF HOUSING AND LITTER ON PRODUCTION OF BROILERS,**
Georgia Univ., Athens. Dept. of Poultry Science.
M. G. McCartney.

Poultry Science, Vol 50, No 4, p 1200-1202, July 1971. 2 tab, 8 ref.

Descriptors: *Air ventilation, *Consumptive use, *Efficiency, Disease, Chicken, Air contamination.
Identifiers: *Mortality, Enclosed housing, Open housing, White Plymouth Rock, Reused litter, Windowless type housing, Marck disease, Leukosis.

There has been considerable interest in the use of windowless-type houses for the production of broilers in the South. It is of general agreement that houses with fan ventilation are superior to the conventional house with respect to growth, feed conversion, mortality and condemnation of broilers to market age. The results of tests run to verify the hypothesis indicated that there were no real differences in the performance of broilers grown in open or enclosed housing or on new or old litter. Therefore, under the conditions of this study it is not possible to justify the cost of providing insulated, fan-ventilated housing for broilers. Also, since the type of litter did not affect condemnation, it is similarly not justified to recommend the use of new litter between successful lots of broilers from the standpoint of mortality or condemnations. (Bundy-Iowa State)

### 0461-A11, C3, D2, E3

**FUMIGATION AND REUSE OF BROILER LITTER,**
Hawaii Univ., Honolulu. Dept. of Animal Science.
E. Ross, and A. Y. Miyahara.
Poultry Science, Vol 50, No 4, p 1096-1100, July 1971. 4 tab, 12 ref

Descriptors: *Bacteria, Poultry, Disease, Feeds, Bactericide, Microorganisms.
Identifiers: *Methyl bromide, *Mortality rate, Reused litter, Coccidia, Concentration, Weight gain, Sterilized poultry litter, Broilers, Soil, Fumigant, Build up litter.

The scarcity of conventional litter material in some parts of the country is an increasing concern to broiler producers. The effect of methyl bromide fumigation of reused litter on chicken growth, feed conversion and mortality was investigated as a possible solution. To test these effects 6 trials on commercial broiler chicks were made. In 6 trials, commercial broiler chicks were reared on fresh wood shavings litter, reused wood shavings litter and reused wood shavings litter that had been fumigant with 1-10 kg. of methyl bromide/20.5 m.2 of litter. Increasing levels of fumigant reduced the bacterial count in the litter without achieving sterilization and without otherwise affecting weight gains, feed conversion or mortality. (Bundy-Iowa State)

### 0462-A11, B1, C1, C2, E3, F6

**NUTRIENT DIGESTIBILITY USING FECAL COLLECTION APPARATUS AND INDICATOR METHOD FOR STEERS FED AD LIBITUM,**
Kentucky Univ., Lexington.
P. A. Phar, N. W. Bradley, C. O. Little, L. V. Cundiff, and J. A. Boling.
Journal of Animal Science, Vol 33, No 3, p 695-697, September 1971. 4 tab, 12 ref.

Descriptors: *Digestion, *Nutrients, Analytical techniques, Animal waste, Confinement pens, Cattle.
Identifiers: *Chromic oxide indicator, *Fecal collection apparatus, Pelleted ration, Ad libitum, Feed trial, Crude protein, Crude fiber, Ether extract, Gross energy coefficient, Steer.

Six 2-year-old steers weighing an average of 453 kg were randomly assigned to a cross-over design to study the effects of fecal collection apparatus on the apparent digestibility of nutrients when a complete, pelleted ration was fed ad libitum and to compare total collection versus chromic oxide indicator coefficients. Chromic oxide was mixed with the ration prior to pelleting at the rate of 0.5%. Fecal samples were taken twice during a 24-hr. period and composited at the end of the 6-day collection period for each steer. Sampling times representing each 2-hr. interval were randomly assigned to days. Average daily feed intake was not significantly affected by fecal collection apparatus. There was no significant difference in crude protein, crude fiber, ether extract, N.F.E. or gross energy coefficients calculated by the conventional and indicator methods; however, there was a significantly (PA.01) lower dry matter coefficient when calculated by indicator method. When the indicator method of estimating digestibility was used to compare the effect of collection apparatus versus no apparatus on digestibility of nutrients, the N.F.E. digestibility was significantly (PA.05) lower in the steers without the fecal collection apparatus. Coefficients of digestibility for dry matter, crude protein, crude fiber, ether extract and gross energy were not significantly (PS.05) affected by fecal collection apparatus. (Bundy-Iowa State)

### 0463-A8, C2, E2

**CHEMICAL COMPOSITION OF POULTRY MANURE.**

Poultry Digest, p 439-441, September 1971. 4 tab.

Descriptors: *Chemical waste, *Crop response, Essential nutrients, Chemical analysis, Poultry, Organic acids, Rates of application, Nutrients.
Identifiers: *Broiler houses, *Micronutrients, *Laying house, Wasted feed.

The value of poultry manure as a crop fertilizer has been measured primarily in terms of nitrogen, phosphorus, and potassium. Very little consideration has been given to the micronutrients content. There are substantial amounts of calcium, magnesium, and sulfur. The micronutrients includes manganese, iron, boron, copper, zinc, and molybdenum. The mean calcium and magnesium contents of broiler manure were 1.97 and 0.37%, respectively, which were less than for hen manure with calcium content of 3.42% and magnesium of 0.52%. With present knowledge of the requirements of most crop plants for micronutrients indicates that, except in cases of extreme deficiency, application of three to five tons per acre of broiler or hen manure annually would maintain and adequate supply of these elements. (Bundy-Iowa State)

### 0464-C2, F6

**EXTRACTION OF BILE ACIDS FROM RAT FECES CONTAINING CHOLESTYRAMINE,**
Mead Johnson Research Center, Evansville, Ind. Dept. of Nutritional Research.
J. D. Manes, and D. L. Schneider.
Journal of Lipid Research, Vol 12, No 3, p 376-377, 1971.

Descriptors: *Gas chromatography, *Rodents, Chemical analysis, Laboratory animals, Laboratory tests, Methodology, Test procedures, Analytic techniques.
Identifiers: *Bile acids, Gas-liquid chromatography, OV-21.

The fecal extraction procedure described by Evrard and Janssen was inadequate for the complete extraction of conjugated bile acids from feces containing the bile acid sequestrant, cholestyramine. As judged by gas-liquid chromatographic analysis, substitution of 0.5 n HCl in absolute ethanol for glacial acetic acid allowed for complete recovery (98-104%) of three different conjugated bile salts in the presence of the resin. (Parker-Iowa State)

### 0465-A1, A11, A12 C2

**FEED ADDITIVE RESIDUES IN POULTRY MANURE,**
Agricultural Research Service, Beltsville, Md.
C. C. Calvert.
Poultry Digest, August 1971, p 396-398.

Descriptors: *Poultry, *Feeds, *Additives, Arsenic compounds, Animal diseases, Farm wastes, Antibiotics, Environmental effects.
Identifiers: *Feed additives, Residues, Growth stimulants.

At this stage, very little is known as to the potential hazard to the environment represented by commonly used feed additives. The amount of residues excreted and the composition of that residue of such additives as antibiotics, arsenicals, nitrofurans and others are discussed. Studies are cited giving the present state of knowledge on these residues and their pollutional effects on the environment. (Parker-Iowa State)

### 0466-A2, A5, C2

**INFILTRATION RATES AND GROUNDWATER QUALITY BENEATH CATTLE FEEDLOTS, TEXAS HIGH PLAINS,**
Texas Tech Univ., Lubbock. Dept. of Geoscience.
William D. Miller.
Environmental Protection Agency-Water Quality Office, Water Pollution Control Research Series Report, January 1971. 55 p, 26 fig, 11 tab, 6 ref. EPA Program 16060 EGS 01/71.

Descriptors: *Nitrates, *Groundwater, Water quality, *Infiltration, Soils, Drainage, Seepage, Runoff, Water pollution sources, Path of pollutants, Water analysis.
Identifiers: *Ogallala formation, *Core chemistry, Permeability, *Texas High Plains, Geologic environment, *Feedlot runoff.

Detailed field and laboratory studies of five feedlots were conducted to determine field seepage rates and distributive geometry of infiltrated runoff. Practical field seepage rates at these sites ranged from 2 to 20 feet/year. Dispersal rates of ions in the groundwater zone varied from 45 to 400 feet/year. Nitrogen (NO3, NO2, NH4, Org-N) and common chemical parameters (Ca, Mg, Na, K, Cl, SO4, TDS, pH, and conductance) were determined in cores and groundwater samples; based on groundwater analyses from 80 Texas High Plains feedlots, rates of concentration of NO3-N and Cl in groundwater beneath feedlots range from 0.07 to 0.4 p.p.m. per year, and average 0.17 p.p.m. per year. Laboratory determined constant head vertical permeability of cores from 22 feedlot sites revealed a range in values of .01 to .000001 cm/sec for Ogallala sediments, .0001 to 10 to the minus 7th power cm/sec for near-surface material of floodplains and feedpen-runoff surfaces, and values of .000001 to 10 to the minus 8th power cm/sec for playa clay. Factors related to runoff-infiltration were correlated with groundwater quality, and it was determined that local surficial material and regional soils patterns are closely related to quality of groundwater beneath feedlots. Direct correlation of water quality does not exist with feedpen-runoff slope, cattle load, and surface-area ratios of drainage basin to collection system.

### 0467-A6, A7, C2, F6

**IDENTIFICATION OF FEEDLOT ODORS,**
California Univ., Riverside. Statewide Air Pollution Research Center.
J. Fosnaugh, and E. R. Stephens.
Statewide Air Pollution Research Center (final report), Grant No U100531-02, p 1-24, April 30, 1969. 3 fig, 2 ref.

Descriptors: *Chromatography, Ionization, Laboratory tests, *Odors, Chemical analysis, *Farm wastes, Organic compounds, Cattle, *Pollutant identification.

Identifiers: *Feedlot odors, Field analyzing technique, Ambient concentration, Ionization detector, Trimethylamine, Amines.

The proximity of cattle feedlots to suburban housing has created local air pollution problems which in some instances have forced feedlots to cease operation or to move. The principal objective of this project was to identify the odorant compounds and to develop methods for their detection and measurement. Several pieces of evidence point to the light weight amines as the principal offenders. In particular, trimethylamine has an odor threshold below 1 ppb and can be detected in feedlot air at concentrations above this. Other amines, ammonia, and perhaps other compounds may also contribute to the odor. Of the several analytical methods tested gas chromatography and paper chromatography showed the most promise. Neither was developed into routine use. (Bundy-Iowa State)

### 0468-A7, A11, B1, B4, C2

**EFFECT OF VENTILATION ON THE GAS CONCENTRATION IN A PART-SLATTED PIGGERY,**
North of Scotland Coll. of Agriculture, Aberdeen. Scottish Farm Buildings Investigation Unit.
A. M. Robertson, and H. Galbraith.
Farm Building Research and Development Studies, May 1971. 9 fig, 3 tab, 21 ref.

Descriptors: *Gases, *Hogs, *Ventilation, Effects, *Carbon dioxide, *Ammonia, *Hydrogen sulfide, Air circulation, Waste storage, Storage tanks, Environmental effects, Temperature, Toxicity, Animal physiology.
Identifiers: *Gas concentration, Slotted floor, Manure, Swine.

The concentrations of carbon dioxide, ammonia, oxygen, and hydrogen sulfide were recorded over the dung channel of a slatted floored house for growing/finishing pigs. Data was collected at ventilation rates varying from 0.262 m cu/h kg to 1.234 m cu/h kg live weight and during emptying of the channel. At summer ventilation rates concentrations of 7.6 ppm $H_2S$, 9.1 ppm $NH_3$ and 600 ppm $CO_2$ were recorded. Concentration of toxic gases increased with volume of manure in the channel and depended on the ventilation rate. At winter rates concentrations in excess of 20 ppm $H_2S$ were recorded. (Parker-Iowa State)

### 0469-A6, F2

**WHY DOES IT SMELL SO BAD,**
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
Clyde L. Barth.
Paper presented at the 1970 Annual Meeting American Society of Agricultural Engineers, ASAE 70-416. 22 p, 5 fig, 1 tab, 65 ref.

Descriptors: *Odor, Farm wastes, Pollutants, Strength, Temperature, Instrumentation, Measurement.
Identifiers: *Smell, Olfactory mechanism, Perception, Theories, Literature, Odor quality, Stimuli.

Researchers must learn more about manure odor production and control. Many unanswered problems face the farmer now. A review of pertinent literature clarifies the present status of the knowledge of odor perception, and creates an awareness of the pitfalls to be avoided in planning, conducting and analyzing odor related research. (Christenbury-Iowa State)

### 0470-A6, B3, D1, D2, F2

**CONTROLLING ODORS FROM CATTLE FEED LOTS AND MANURE DEHYDRATION OPERATIONS,**
Memphis Cattle Feeders, Inc., Millington, Tenn.
Robert Moorman, Jr.
Air Pollution Control Association Journal, Vol 15, 1965, p 34-35.

Descriptors: *Farm wastes, *Odors, Legal aspects, Dehydration, Spraying, Disposal, Management.
Identifiers: *Feedlots, Public relations.

This paper discusses various methods of odor control for cattle feed lots. The human and physical conditions that exist which allow and cause odor problems to arise and become a community source of trouble are discussed. These include a negative attitude and a lack of understanding on the part of the parties concerned. The odor problems can be alleviated through cooperation and sincere effort. The use of dehydration units have been only partially successful. Public relations between feed lot and the community are very important. (Christenbury-Iowa State)

### 0471-B3, C1, D1

**ACCELERATION OF NATURAL DRYING OF POULTRY MANURE THROUGH MECHANICAL AGITATION,**
California Univ., Davis.
James A. Moore, and Samuel A. Hart.
Unpublished paper. Presented Pacific Coast Region American Society of Agricultural Engineers, 1968. Paper No PC 68-121. 2 fig, 2 ref.

Descriptors: *Farm wastes, *Sublimation, Drying, Moisture content, Till, Winter, Freeze drying, Freezing, Equipment.
Identifiers: Relative humidity, Tiller drying, Natural drying.

Wet manure rather quickly becomes objectionally odorous. One solution to the manure problem would be an economical and efficient means of reducing the moisture content. The concept of sublimation was evaluated as a means of natural drying of poultry manure. The use of a mechanical agitator was incorporated into the system. The drying phenomenon that allows clothes to dry in winter weather would not work with manure. The tiller-drying to accelerate natural drying of manure in summer was very effective. (Christenbury-Iowa State)

### 0472-A2, A6, B2, B4, E2

**A YEAR IN THE LIFE OF A SLURRY COMPOUND,**
J. M. Kindell.
Agriculture, Vol 78, No 6, p 268-269, June 1971.

Descriptors: *Farm waste, Cattle, Surface runoff, Slope, Economic feasibility, Waste storage, Storage capacity, Porosity, Odor, Waste disposal.
Identifiers: *Dairy cattle, Slurry compound, Slurry disposal, Feed ration.

To eliminate the difficulty of spreading the slurry compound from a dairy farm in northern Chilterns, a storage tank to hold the full winter's storage of slurry was built. The system was built for an operation of sixty Friesian milkers. The storage area, 90 ft. long and 66 ft. wide, was excavated to an average depth of 2 ft. which produced sufficient flinty clay material to form the side and end walls. The excavated clay was used to built a bank around the area which would hold the slurry to a depth of about 3 to 4 ft. The disposal system was reasonably cheap to install, operate, and maintain and it avoided the daily or weekly chore of manure disposal in the winter. No smell, fly or other nuisance arose during the period of storage in the compound. On emptying, the smell, although powerful, was of limited duration. The amount of percolation into the subsoil appeared to be negligible on account of the clay-based subsoil forming the floor of the compound. In calculating the storage capacity of the slurry compound, it seems prudent to be on the generous side. Half a cubic yard per cow per week for the winter housing period is a useful guide. (Bundy-Iowa State)

### 0473-C1, C2

**BOD OF CAPTIVE WILD ANIMAL WASTES,**
Tulane Univ., New Orleans, La. Dept. of Civil Engineering.
F. W. Macdonald, and H. R. Davis.
Water and Sewage Works, Vol 113, February 1966, p 64-67. 2 tab, 2 ref.

Descriptors: *Biochemical oxygen demand, Animals, Animal wastes (Wildlife).
Identifiers: *Wild animals, *Zoo, Total solids, Captive animals, Primates.

The findings of an analysis of the animal waste from a zoo are reported. The total solids and the BOD per pound of animal are reported. The results of this study may well serve as a guide in the design of plants for the disposal of wild animal wastes. (Christenbury-Iowa State)

### 0474-B2, B3, C1, C2

**PROPERTIES AND PUMPING CHARACTERISTICS OF HOG WASTES,**
E. P. Taiganides, T. E. Hazen, E. R. Baumann, and H. P. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol 7, p 123-124, 127, 129, 1964. 3 fig, 1 tab.

Descriptors: *Farm wastes, *Hogs, *Properties, *Pump testing, Solid wastes, Performance, Pumping, Efficiencies, Biochemical oxygen demand, Waste identification.
Identifiers: *Waste properties, *Characteristics, Volatile solids.

Hog wastes from a confinement hog production unit were analyzed for daily quantity and physical and chemical properties. The pumping characteristics of the untreated hog wastes were determined with a diaphragm pump and a 6-inch auger. The quantity and quality of the manure are affected primarily by the size of the hogs, the type and quantity of the feed intake, the quantity of the water intake and the air temperature. The daily quantity of manure removed varies with the time of year. The average total solids content of the manure was 18.5 percent and 15.6 percent during the hot and cold months of the year respectively. The total nitrogen of the manure was 7 percent of the total dry matter. Results of the auger pumping test showed that manure can be pumped with greater efficiency and less power consumption than water. With the diaphragm pump the maximum pumping capacity for water is obtained at a higher pump speed than for manure under similar conditions of operation. The results of the pumping tests were presented graphically. (Parker-Iowa State)

### 0475-A8, B1, C2, E2

**LIQUID DIGESTED SEWAGE SLUDGE GIVES FIELD CROPS NECESSARY NUTRIENTS,**
O. C. Braids, M. Sobhan-Ardakani, and J. A. E. Molina.
Illinois Research, Vol 12, No 3, Summer 1970, p 6-7. 3 tab, 1 fig.

Descriptors: Sludge, Sludge disposal, *Sewage sludge, *Nutrients, Nitrates, Analysis, *Field crops, Crop production, Soil analysis, Leaching, Corn, Sorghum, Lysimeters.
Identifiers: Digested sludge, Heavy metals, Reed canary grass, Drain water.

Irrigation of cropland with digested sludge is seen as a way of recycling the elements and reducing ultimate disposal costs. To learn more about this subject, a study utilizing an existing lysimeter facility was conducted. A digested sludge having a solids content of 2 to 4 percent by weight was obtained from a sewage treatment plant. A 1-inch application of sludge on an acre contains about 330 pounds of nitrogen, 180 pounds of phosphorus and 40 pounds of potassium. Corn, Reed canary grass, and grain sorghums were grown with two levels of sludge irrigation; 10 inches in 1968 and 7 inches in 1969. This level, without exception, produced yields as good as, or better than, those obtained with water irrigation and relatively high levels of commercial fertilizer. In this test crop and leaf analysis were made as well as soil analysis. The drain water was also analyzed. One problem noted was the increased concentration of nitrate-nitrogen found in the water from the sludge-treated plots. The nitrogen content of digested sludge appears to be the first limiting factor to loading rate. (Parker-Iowa State)

### 0476-A11, B3, C3

**THE MICROFLORA OF SOUTHERN OHIO POULTRY LITTER,**
J. Lovett, J. W. Messer, and B. Read, Jr.
Poultry Science, Vol 50, No 3, May 1971, p 746-751. 7 tab, 17 ref.

Descriptors: *Farm wastes, *Poultry, *Microorganisms, Ohio, Chemical analysis, Analytical techniques, Salmonella, Cultures, Coliforms, E. coli, Molds, Fungi, Plants, *Waste identification.
Identifiers: *Microflora, Total count, Poultry litter.

Poultry litter from four Southern Ohio farms was analyzed; the microflora was enumerated, and the fungal population was classified to genera. At each farm, litter was taken from several areas within the poultry house. Composite litter samples were ground in a Wiley mill. Three media and two incubation methods were evaluated before deciding on the total count procedure. TSA consistently yielded greater counts than either PCA or STCM. Litter pH and total bacterial and fungal counts increased with litter usage to about one month, then declined slightly and remained constant thereafter. Coliform and Escherichia coli were constant throughout the sampling period for all litter. After one week of litter use, approximately 10 per cent of the total microbial population was found to consist of coliform. Twelve fungal genera were identified from poultry feeds. A wider variety of mold genera was isolated from litter. (Parker-Iowa State)

### 0477-A6, A8, C1, C3, D3

**BIOLOGICAL CONVERSION OF ANIMAL WASTES TO NUTRIENTS,**
Colorado State Univ., Fort Collins. Dept. of Avian Science.
B. F. Miller.
Final report, May 1971. 69 p, 9 fig, 10 tab, 36 ref, append. Project no. HGW-PHS Solid Wastes Research Grant EC-00262-02.

Descriptors: *Farm wastes, *Lagoons, *Chemical analysis, Crop response, Anaerobic bacteria, Odor, Amino acid, Poultry, Cattle, Larvae, Incubation, Organic matter, Soil structure, Economics, Nutrients.
Identifiers: *Feed analysis, Automated manure handling, Caged laying, Crop yield, Plant nutrients.

Fly eggs were placed in fresh poultry manure under different temperature (22 to 38C) and relative humidity (19 to 80%) conditions to determine the hatchability of fly eggs, growth of larvae, production of pupae and physical changes in the poultry manure. Moisture loss from the manure was recorded daily. The inoculation rates varied from 2 g. to 5 g. fly eggs per 4000 g. of fresh poultry manure. Fly eggs and larvae were also placed under caged laying hens for the catabolism of the manure as it was voided. Optimum yield of dry pupae was obtained with a combination of 3 g. fly eggs in 4000 g. of fresh poultry manure at 27C and relative humidity of 41%. Moisture in the manure was reduced from 78.5 to 55.0%. When relative humidity was increased from 38 to 70% the yield of pupae at 34 to 38C was significantly (PA0.01) increased. The combination of 2 g. eggs per 4000 g. of fresh manure produced significantly (PA0.01) heavier larvae. Hatchability of fly eggs in fresh poultry manure varied from 50.5 to 87.0%. In comparison to fresh poultry manure, the manure residue had less odor, contained less moisture and was granular in texture. The fly larvae developed well under the caged layers, reducing freshly voided manure to granular material within a few hours. (Bundy-Iowa State)

### 0478-A6, B2, C2, D2, D3

**LABORATORY STUDIES OF AEROBIC STABILIZATION OF SWINE WASTE,**
Minnesota Dept. of Health, Glenwood; Illinois Univ., Urbana. Dept. of Agricultural Engineering.
R. L. Irgens, and D. L. Day.
Journal of Agricultural Engineering Research Vol 11, No 1, p 1-10, 1966. 6 fig, 7 tab, 11 ref.

Descriptors: *Farmwastes, *Swine, Aerobic treatment, Waste disposal, Chlorination, Waste treatment, Oxygenation, Oxidation lagoons.
Identifiers: Aerobic stabilization, Swine waste treatment, Aeration of wastes.

Pig waste was allowed to accumulate in a pit beneath a slattered floor swine finishing building for one week or one month. Samples of this waste were brought to the laboratory for analysis and aerobic stabilization. It was concluded that adding raw waste continuousoly to the aeration unit gave the best results. The treated effluent had a BOD of 10 to 15 p.p.m. and contained only a trace of ammonia. Treatment by the aerobic process made the swine waste virtually odorless and stable. About 6 ft. 3 of liquid was required to dilute the waste from 150 lb. pig at the beginning of the aerobic process and 2500 ft. 3 of air was needed per pound of BOD. However, the more efficient oxygenation obtained with an aeration rotor in an oxidation ditch might reduce the latter value considerably. It was estimated that 36 KWh might be required per pig per year for operation of the aeration rotor of an oxidation ditch chlorination of diluted swine waste eliminated a certain degree of odor and improved flocculation and dewatering of the solids. The COD of the chlorinated and filtered waste was reduced 72%. Chlorinated compounds of various types may have similar effects. (Hazen-Iowa State)

### 0479-A7, A11, B1, C2

**THE INFLUENCE OF GRADED LEVELS OF ATMOSPHERIC AMMONIA ON CHICKENS,**
Nottingham Univ. (England). School of Agriculture.
D. R. Charles, and C. G. Payne.
British Poultry Science, Vol 7, p 177-187, 189-198, 1966. 16 tab, 32 ref.

Descriptors: *Farm wastes, *Environmental effects, *Air pollution, *Air pollution effects, Growth, Rates, Respiration, Performance, Productivity, Ventilation, Air circulation, Poultry , Ammonia, Eggs.
Identifiers: *Ammonia toxicity, *Food consumption, Ammonia concentrations, Respiration rates, Food conversion efficiency.

A detailed description is given of studies done on the effects of air pollution on white leghorn chickens. The studies were done in two parts, one on broilers and replacement chickens and the second on laying hens. One hundred parts per million by volume of ammonia caused reductions in the respiration rates of adult hens between 7 and 24 percent. Broiler chickens from 28 days of age tended to eat less food than those reared in ammonia free atmospheres. At 100 p.p.m. of ammonia their growth rate was significantly reduced. Replacement laying pullets raised in ammonia containing atmospheres from 11-18 weeks of age had reduced food intake than those in ammonia free atmospheres. Pullets raised in atmospheres with high ammonia concentrations matured up to two weeks later than those in atmospheres free of ammonia. Atmospheres of 105 p.p.m. of ammonia significantly reduced egg production after 10 weeks exposure. No effects were observed on egg quality. Voluntary food intake was reduced and live-weight gain was lower in ammoniated atmospheres. High protein, vitamin, and mineral diet prevented the onset of any deleterious effects of ammonia on egg production, even though food consumption fell to 75 g./bird/day at 29 C., 43% humidity and 104 p.p.m. of ammonia when a low energy diet was fed to hens in high ammoniated atmospheres. Their production deteriorated rapidly. (Hazen-Iowa State)

### 0480-A6, B2, C1, C2

**CAGE AND KENNEL WASTE WATER,**
National Institutes of Health, Bethesda, Md. Div of Research Services.
N. A. Jaworski, and J. L. S. Hickey.
This was reported as 'NIH Detergent for Mechanical Washing of Laboratory Glassware and Animal Cages' Sanitary Engineering Branch Project 136 (1955). Journal Water Pollution Control Federation, Vol 34, No 1, p. 40-43, Jan, 1962. 1 fig, 5 tab, 2 ref.

Descriptors: *Waste water disposal, *Biochemical oxygen demand, Waste water, Water analysis, Animal wastes (Wildlife), Waste identification, Waste dilution, Waste water treatment, Laboratory animals.
Identifiers: *Waste water production, Total solids, Volatile solids, Composite samples, Cage cleaning wastes, Kennel.

The National Institutes of Health is planning a laboratory-animal colony in an unsewered area. The waste water from the colony will require treatment on the site. The waste water from cage cleaning and kennel cleaning is expected to represent a large percentage of the total sewage of the colony. A study of the volume and character of the waste water of a similar animal colony to the one porposed was made. Mechanical washers are used to clean the cages. Each washer contains a 1,000-gallon recirculating wash water tank and a 500-gallon, recirculating, rinse water tank. Excess water overflows to the sewers. Samples of the overflow were collected at 30-minute intervals. These samples were composited in proportion to the quantity of waste water from each machine. The BOD IN THE OVERFLOW WAS LESS THAN THAT IN THE WASTE WATER DRAINED FROM THE TANKS. The PH was 11.0 and the temperature was 140 to 160F of the waste water. The BOD, total solids, and volatile solids of the waste water from hosing of the pens was approximately three times per unit volume as that found in domestic sewage. The waste water has a sharp, unpleasnat odor, which might constitute a problem when it is treated in a population area. (Hazen-Iowa State)

### 0481-A8, B2, D3, E2, F1

**RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,**
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Herman Bouwer.
Journal of Soil and Water Conservation, Vol 23, 1968, p. 164-168, 2 fig, 1 tab, 22 ref.

Descriptors: *Irrigation, *Water reuse, *Waste disposal, Sewage effluents, Water quality control.
Identifiers: *Waste water renovation, Land disposal.

This article discusses the use of land or soil to dispose of and treat domestic, industrial, and agricultural sewage and wastes. Several projects are mentioned where this is being done on an experimental or trial basis. The major objectives may be sludge removal, groundwater renewal, irrigation or a combination of the three. The soil purifies the waste. Nutrients are also supplied to plants if the amount of effluent applied is not excessive. The economics of land disposal is also discussed. A more detailed description is given of the Flushing Meadows Project near Phoenix, Arizona. (Parker-ISU)

### 0482-A3, A4, A5, A12, C2, E2

**THE EFFECT OF FARM WASTES ON THE POLLUTION OF NATURAL WATERS,**
Wisconsin Univ., Madison; and Marathon County Center, Wausau, Wis.
S. A. Witzel, N. E. Minshall, E. McCoy, R. J. Olsen, and K. T. Crabtree.
Paper No. 69-428 presented at the 1969 Annual Meeting, American Society of Agricultural Engineers at Purdue University, W. Lafayette, Indiana. June 22-25, 1969. 24 p, 2 fig, 4 tab, 14 ref. Project No. OWRR B-004-WIS (12).

Descriptors: *Farm wastes, *Groundwater, *Nutrients, *Water pollution, Nitrates, Nitrites, Potassium, Phosphorus, Wells, Supplemental irrigation, Fertilizers, Fishkill, Eutrophication.
Identifiers: *Groundwater pollution, Well contamination, Algal growth, Deoxygenation.

Natural surface waters are subject to enrichment with the plant nutrients N, P, and K, and subsurface waters are often subject to pollution with nitrate and nitrite nitrogen. A study was begun in 1963 to determine the sources and amounts of plant nutrient losses from agricultural operations and to locate any health hazards that may result from the disposal of farm animal wastes. Nutrient losses in the base flow of southwestern Wisconsin streams during the period of high winter runoff totaled only 25% as much N and K and 10% as much P as in the surface runoff. Heavy manure applications in the vicinity of farm buildings or large feedlot operations can result in dangerously high nitrate concentrations in farm wells. Heavy supplemental irrigation combined with heavy nitrogen fertilizer application may result in an increase in the nitrates in ground water. Heavy annual applications of manure and/or fertilizer to large land masses which allow more than 13.5 lb. per acre of nitrogen to pass beyond the root zone could raise the groundwater to the toxic level of nitrates, assuming that all the nitrogen reaches the groundwater and that the aquifer is static. (Dorland-Iowa State)

### 0483-A4, A6, A7, B2, B3, B4, C2, C3, E1, E2, F2

**HOW CAN PORK PRODUCERS COMPLY WITH ENVIRONMENTAL QUALITY STANDARDS,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. Ronald Miner.
American Pork Congress-Proceedings, Environmental Quality Workshop, Des Moines, Iowa, Mar 3, 1971. p 98-102.

Descriptors: *Farm wastes, *Hogs, *Environment, *Pollution abatement, Water quality, Standards, Water pollution, Air pollution, Odor, Confinement pens, Organic matter, Nutrients, Nitrogen, Phosphorus, Eutrophication, Algae, Pathogenic bacteria, Effluent, Irrigation, Storage, Waste disposal.
Identifiers: *Environmental quality, Air contaminant, Stream quality, Waste management, Manure collection, Manure transport.

To prevent water and air pollution while maintaining environmental quality is a complex problem. It becomes more complicated by trying to design waste management systems which contribute materially to our effectiveness as pork producers with pollution control as a side benefit. A swine manure management system might include a collection device, a manure transport system, some means of manure storage and/or treatment, and finally, a manure or effluent disposal system. In some cases more than one of these components may be included in a single component. Giving initial consideration to the disposal scheme will help determine decisions to be made concerning the other aspects of the system. There is much remaining to be learned relative to the control and measurement of odors. Various odor levels can be achieved by the judicious selection of manure handling techniques. (White-Iowa State)

### 0484 - A4, C3

**RELATIONSHIPS OF SALMONELLAE TO FECAL COLIFORMS IN BOTTOM SEDIMENTS,**
Environmental Protection Agency, Cincinnati, Ohio. Div. of Water Hygiene.
D. J. VanDonsel, and E. E. Geldreich.
Water Research, Vol 5, No 11, p 1079-1087, November 1971. 3 fig, 3 tab, 21 ref.

Descriptors: *Indicators, *Salmonella, *Sediment-water interfaces; Coliforms, Sampling, Mud-water interfaces, Water quality, Sediments, Pathogenic bacteria, Streptococcus, Domestic wastes, Farm wastes, E. coli, *Bottom sediments.
Identifiers: *Bottom sampler, Resuspension, Bacterial concentration.

The use of bottom sampling in water quality investigations is presently limited; however, the mud may serve as a concentrated and stable index of the quality of the overlying water. Salmonellae can be isolated from bottom sediments with far greater frequency than directly from the overlying water. Salmonellae were isolated from 19 percent of the mud samples when fecal coliform density in the overlying water was between 1 and 200 per 100 ml; from 50 percent between 201 and 2000; and from 80 percent over 2000. Fecal coliform to fecal streptococcus ratios of the overlying waters indicated that most of the isolated salmonellae originated in domestic sewage, but there were some positive samples with low ratios, which suggests that their salmonellae came from livestock or wildlife. Mud-water interfaces are not static systems, sludge banks can shift to a new position in response to currents, storms, and dredging operations. The consequent recirculation of older pollutants poses new problems in water quality which must be considered. (Dorland-Iowa State)

### 0485-A11, E2, F2

**POULTRY LITTER AS CATTLE FEED,**
Missouri Univ., Columbia. Dept. of Animal Husbandry.
Melvin Bradley, and Walter Russell.
Feedstuffs, Vol 37, No 8, p 59-60, February 20, 1965.

Descriptors: Farm wastes, Legal aspects, Feeds, Missouri, Poultry, Hazards, Efficiencies.
Identifiers: Broiler litter, Bloat, Rate of gain.

This article reviews the literature on feeding of poultry litter to beef cattle, discussing hazards and legal implications and giving recommendations if litter is used as a feed. Research is reviewed from Texas, Arkansas, Georgia and Virginia. (Christenbury-Iowa State)

### 0486-A1, B2, B3, C1, C2, C3, D1, D2, D3, E1, F4,F5

**FARM ANIMAL-WASTE MANAGEMENT.**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.

Miner, J Ronald (Ed). North Central Regional Publication 206, Special Report 67, May 1971. 44 p, 34 tab, 85 ref.

Descriptors: *Farm wastes, *Disposal, Waste water treatment, *Management, Hydroponics, Incineration, Pollutants, Diseases, Design criteria, Anaerobic digestion, Aerobic treatment, Aerobic bacteria, Zoonoses, Anaerobic bacteria, Farm lagoons, Chemical properties, Physical properties, Pathogenic bacteria, Environmental effects.
Identifiers: Composting, Oxidation ditches, Ruminant digestion, Nonruminant digestion, Disease transmission, Feedlot-runoff.

Current practices, technology, knowledge, and research results are summarized as related to the management and disposal or use of farm animal wastes in the 13 states of the North Central Region and other cooperating states. Among alternative systems of management and treatments described, attention is given to relative effectiveness in eliminating or minimizing detrimental environmental and ecological consequences. Detailed information is included on the biology and biochemistry of waste treatments; characteristics of animal wastes, including biological, physical, and chemical properties; aerobic, anaerobic, and combined treatments of animal wastes; composting, incineration, dehydration, and hydroponics; and actual and potential productive utilization of animal wastes. Needs for additional research are suggested. (Christenbury-Iowa State)

### 0487-B2, C1, C2, D1, D3, E4, F1, F6

**NITRATE REMOVAL FROM AGRICULTURAL WASTE WATER,**
Federal Water Pollution Control Administration, Fresno, Calif.; and California Dept. of Water Resources, Fresno.
Percy P. St. Amant, and Louis A. Beck.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 1-8. 1 tab, 1 fig.

Descriptors: *Return flow, *Nitrates, Water pollution, Desalination, Algae, Denitrification, California, Filters, Particle size, Anaerobic conditions, Waste water treatment.
Identifiers: *Nitrate removal, Algae stripping, Pond denitrification, Filter denitrification, Methanol, Bacterial denitrification, San Joaquin Valley.

The problem of disposing of irrigation waste water from the San Joaquin Valley of California is a very large one. The most serious potential pollutant is nitrogen in the nitrate form. A waste water treatment center at Firebaugh, California has organized and is carrying out research in the areas of desalination, algae stripping, and bacterial denitrification. Algae stripping simply involves growing a crop of algae to remove nitrogen from the water, and then harvesting the algae. Various markets have been proposed for the use of algae. Two methods of bacterial denitrification being explored are pond denitrification, and filter denitrification. The three denitrification methods are compared as to land requirements and project costs. Each is nearly the same in cost - around $10 per acre foot, however the algae stripping method requires much more land. (White-Iowa State)

### 0488-A4, F2

**THE EFFECTS OF SALINITY STANDARDS ON IRRIGATED AGRICULTURE IN THE COLORADO RIVER BASIN,**
Federal Water Pollution Control Administration, Boulder. Colorado River - Bonneville Basins Office.
Gary N. Dietrich, and L. Russell Freeman.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 9-15.

Descriptors: *Salinity, *Water quality, *Standards, Colorado River, *Irrigation, Evapotranspiration,

Desalination, Flow augmentation, Consumptive use, Water pollution effects.
Identifiers: *Salinity criteria, Irrigation cycle, Salinity-source abatement.

This paper discusses salinity criteria for the Colorado River Basin. The problem faced in water quality management in the Colorado River Basin is one of improving existing mineral quality, or at least, minimizing future salinity increases. Consumptive use of water in crop production complicates developing salinity criteria for the Colorado River Basin. There are only two direct approaches to implementing salinity criteria: the regulation of consumptive water uses and the desalination of waters whose salinity has been concentrated by consumptive use. Three salinity control approaches which do not necessarily depend on the establishment of criteria are: the abatement of salinity at selected sources including natural sources, the augmentation of river flows, and the desalination of water for use.
(White-Iowa State)

### 0489-A4, B2, D3, F1

**WATER QUALITY REQUIREMENTS AND REUSE OF WASTE WATER EFFLUENTS,**
Federal Water Pollution Control Administration, Washington, D.C.
Stanley J. Dea.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 37-44. 1 tab.

Descriptors: *Water quality, *Waste water treatment, *Water reuse, Effluent, Waste water, Water Quality Act, Beneficial use, Water supply, Biological treatment, Sewage effluents, Filters, Activated sludge, Tertiary treatment.
Identifiers: *Nutrient removal.

From the overall view of potential water supply shortages in the United States, advanced waste treatment has the greatest promise at locations where the municipal waste water is presently discharged into the ocean or other sinks, and is lost for reuse. An advanced waste treatment facility for turning waste discharges into potable water is described for New York City. The most urgent needs in sewage treatment technology include modifications of 'conventional' processes and advanced or tertiary treatment. Advanced treatment for the removal of nutrients, organics, and inorganics can be accomplished for about 26-30 cents/1000 gallons compared to 11 cents/1000 gallons for secondary treatment. However, the reclaimed waste water from advanced treatment has economic utility and value for reuse.
(White-Iowa State)

### 0490-A4, A5, C2

**SALINITY CONTROL IN RETURN FLOW FROM IRRIGATED AREAS - A DEMONSTRATION PROJECT,**
Colorado State Univ., Fort Collins. Natural Resources Center.
Norman A. Evans.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 45-55. 7 fig.

Descriptors: *Salinity, *Return flow, *Irrigation, Colorado River, Salt balance, Canal seepage, Deep percolation, Evapotranspiration, Electrical conductance, Base flow.
Identifiers: Salt load.

The purpose of this paper was to summarize a demonstration project which has been initiated in the Grand Valley area of Colorado for the purpose of showing that saline agricultural return flows are controllable and that if improvements in water management practices are applied, the salt load returning to the river will be reduced. A discussion is given on the mechanics of return flow. Six irrigation companies, a power company, and a drainage district combined resources to form a corporation for the purpose of conducting the demonstration and study. The first step was a before treatment inventory of water and salt budget in the demonstration area. Canal seepage losses have been measured and a plan for lining certain sections is being formulated. Many water flow measurements are being made. Evapotranspiration estimates will be made. Groundwater flow will be calculated from hydraulic gradient and permeability data. Self-monitoring the Colorado River will afford the final evidence of positive benefit from reduction in canal seepage. The reduced canal seepage should reduce by 1/2 the volume of return flow, and affect a significant reduction in salt load.
(White-Iowa State)

### 0491-A4, C2, C3, D1

**WATER QUALITY CONTROL PROBLEMS IN INLAND SINKS,**
Federal Water Pollution Control Administration, Alameda, Calif. California/Nevada Basins.
Richard C. Bain, Jr., and John T. Marlar.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 57-77. 8 fig, 2 tab, 10 ref.

Descriptors: *Water quality, *Salinity, *Sinks, Eutrophication, Fish, Dissolved oxygen, Temperature, Nutrients, Evaporation, Water level fluctuations, Nevada, California.
Identifiers: Pyramid Lake (Nev), Salton Sea (Calif), Total dissolved solids, Surface area.

The problems of Pyramid Lake, Nevada, and Salton Sea, California, are similar in many ways and are common to other inland sinks. Salinity increases and water level fluctuations attributable to water and salt inflows and evaporation losses may be controlled or abated through river basin and water quality management schemes. Pyramid Lake water levels and the rate of salinity increases can be controlled by increasing the water supply to the Lake. Salton Sea salinity and water level problems can be better controlled by salt extraction, lower irrigation efficiencies in nearby agricultural areas, bulkheading on developed parts of the shore, and possible future evaporation pond operation. Eutrophication symptoms, advanced in the Salton Sea and emerging in Pyramid Lake, are less easily manipulated. Natural forces of deposition and consumption of organic matter within these waters will tend to limit nutrient buildup; however trapping and predation effects alone will not eliminate algal blooms. Control of eutrophication must begin with control or elimination of major nutrient sources. It is clear that unless water quality control measures are taken, both bodies of water will eventually become aqueous deserts. Local, State and Federal efforts are underway to preserve or enhance the water quality and associated uses of those two inland sinks. (White-Iowa State)

### 0492-A4, C2, D2, F1

**DISTILLATION OF WASTE WATERS: A WATER RESOURCE FOR ARID REGIONS,**
Federal Water Pollution Control Administration, Washington, D.C. Office of Research and Development.
Allen Cywin, George Rey, Stanley Dea, and Harold Bernard.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 85-94. 14 ref, 2 fig, 1 tab.

Descriptors: *Distillation, *Waste water treatment, Effluent, Potable water, Water reuse, Water quality, Brackish water, Sewage treatment, Costs, Waste dilution, Demineralization, Water resources.
Identifiers: *Blowdown ratio, Salt removal, Mineral content, Total dissolved solids.

The authors propose distillation of municipal waste water for the production of low mineral content water for industrial purposes, particularly for those industries which require such water in large quantities. Distillation has previously been limited in arid regions to applications using saline waters as a feedwater supply. The use of waste water may very possibly result in less costly distilled water. A part of the waste water renovation costs can be attributed to pollution control. Dilution of tertiary-treated effluents with a lower mineral content municipal water can also produce a product water of acceptable mineral content. The lower concentrations of sulfate and total dissolved solids in waste water effluents is also advantageous. Total treatment costs for the processes involved are given.
(White-Iowa State)

### 0493-A3, A4, B2, C2, E1 E2

**NUTRIENTS IN EFFLUENTS FROM ANIMAL PRODUCTION AREAS,**
Missouri Univ., Columbia. Dept. of Agricultural Engineering; and North Carolina State Univ., Raleigh.
Jackie W. D. Robbins, George J. Kriz, and David H. Howells.
Paper presented at 1971 Mid-Central Meeting American Scociety Agricultural Engineers, Paper No MC-71-102. 20 p, 5 fig, 4 tab, 10 ref.

Descriptors: *Farm wastes, *Nutrients, *Coliforms, *Runoff, Management, Phosphate, Nitrogen, Biochemical oxygen demand, Bacteria, Farm lagoons, Pollutants, Disposal, Hogs, Poultry, Cattle, Waste water treatment.
Identifiers: Total coliform, Fecal coliform, Swine, Total Organic Carbon (TOC).

Twelve typical agricultural areas representing three types of animal waste management techniques--land spreading including pasture and drylot units, lagooning and direct discharge into streams--were studied to determine the amounts of and factors governing stream enrichment from swine, dairy, poultry and beef production operations. (Christenbury-Iowa State)

### 0494-A6, B1, C2, F6

**A MODEL STUDY TO DETERMINE THE EFFECTS OF VENTILATION SYSTEMS UPON NH3 CONCENTRATIONS IN SWINE CONFINEMENT HOUSING,**
Ohio State Univ., Columbus. Dept. of Agricultural Engineering; and Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
C. N. Ifeadi, and J. A. DeShazer.
Paper presented 1971 Mid-Central Meeting American Society of Agricultural Engineers, Paper No MC-71-103. 9 p, 1 fig, 1 tab, 2 ref.

Descriptors: *Model studies, *Odors, *Ventilation, *Ammonia, Laboratory tests, Physical models, Structural models, Hogs, Air circulation, Statistical models, Farm wastes, Waste water treatment.
Identifiers: Slotted floors, Airflow rates, Inlet systems, Exhaust systems.

A plexiglass model 1/12 the size of an existing swine building was used to determine the effect of various ventilation systems upon the NH3 concentration in the model. From this investigation, it was found that as more air exhausted below the floor the concentration of NH3 above the floor decreased. Also the inlet settings influenced the concentration of NH3 above the floor. (Christenbury-Iowa State)

### 0495-A3, A4, C2, E2

**CONTAMINATION OF SURFACE WATERS FROM PLOWED-IN FEEDLOT MANURE,**
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
R. I. Lipper, H. L. Manges, and Eugene Goering.
Paper presented at the 1971 Mid-Central Meeting

American Society of Agricultural Engineers, Paper No MC-71-803. 4 p.

Descriptors: *Farm wastes, *Disposal, Confinement pens, Pollutants, Runoff, Chemical oxygen demand, Water pollution sources.
Identifiers: *Feedlot manure, Plowed-in.

When a four-inch layer of beef feedlot manure was completely covered with 2 to 3 inches of soil in small test plots, no organic contamination of water on the soil surface resulted when plots were well drained. Under conditions simulating standing water on tight soil, COD of the water was very high. (Christenbury-Iowa State)

### 0496-B2, C2, D3

**DESORPTION OF AMMONIA FROM ANAEROBIC LAGOON,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. K. Koelliker, and J. R. Miner.
Journal Paper No J-6873 of Iowa Agricultural and Home Economics Experiment Station, Ames. Paper presented 1971 Mid-Central Meeting, American Society Agricultural Engineers, Paper No MC-71-804. 21 p, 6 fig, 2 tab, 9 ref. USDI Public Law 88-379, HEW EC 00283-02.

Descriptors: *Farm wastes, *Anaerobic digestion, Farm lagoons, Biodegradation, Ammonia, Hogs, Disposal, Temperature, Hydrogen ion concentration, Nitrogen cycle, Nitrogen compounds, Laboratory tests, *Mass transfer, *Waste water treatment.
Identifiers: *Anaerobic lagoons, *Nitrogen balance, Ammonia desorption, Nitrogen transformations, Swine.

The loss of ammonia from an anaerobic manure lagoon has been monitored by measurement of ammonia concentrations in air surrounding the lagoon and by a nitrogen balance for the same lagoon from Nov. 1969 - Oct. 1970. Theoretical considerations of desorption and data from the lagoon indicate that the nitrogen loss to the air can be predicted. An anaerobic lagoon may well be a nitrogen sink if no liquid must be removed from it. The rate of ammonia desorption from a lagoon surface is accelerated by increasing alkaline pH, higher temperatures, and increasing wind velocities. (Christenbury-Iowa State)

### 0497-B3, B4, D1, D2,F1

**DEHYDRATION OF ANIMAL WASTES,**
Agricultural Research Service, Columbia, Mo. Transportation and Facilities Research Div.
Herman F. Mayes.
Paper presented at the 1971 Mid-Central Meeting American Society of Agricultural Engineers, Paper No MC-71-805. 15 p, 2 fig, 4 ref.

Descriptors: *Farm wastes, *Fertilizers, *Dehydration, Disposal, Livestock, Economics, Marketing, Economic feasibility, Operating, Storage, Operating costs, Operation and maintenance, Costs, Waste treatment.
Identifiers: Dehydrator design.

Four large terminal livestock markets have been dehydrating cattle and sheep manure since the early 1950's. The dehydrated manure is being merchandised as a specialty fertilizer. The design features of these dehydrators, the operating problems and some typical operating costs are reviewed. These markets have shown that animal wastes can be dehydrated and marketed. While a profit may not have been realized from the sale of this dehydrated manure, it may have been the cheapest method of disposal. (Christenbury-Iowa State)

### 0498-A4, A5, A8, B1, E2

**WATER POLLUTION CONTROL IN CATTLE FEEDLOTS,**
Robert S. Kerr Water Research Center, Ada, Okla.
J. L. Witherow, and M. R. Scalf.
Mimeo, September 1970, 2 fig. EPA Program 13040—09/70.

Descriptors: *Farm wastes, *Water pollution sources, Cattle, Surface runoff, Waste disposal, Waste water disposal, Waste water treatment, Feed lots, Livestock, Confinement pens, Management.

The nature and cause of water pollution from cattle feedlots is briefly described. Current waste management alternatives are dependent upon the rational for land disposal. Two major research projects are described on irrigation with rainfall runoff from the feedpen and on rates of manure disposal on crop lands. Unconventional waste management alternatives involve production process change, reuse of waste through pyrolysis, or refeeding and redesign of the production facilities. (EPA abstract)

### 0499-B2, C1, C2, C3, D3, E1

**MANURE LAGOONS.....DESIGN CRITERIA AND MANAGEMENT,**
Maryland Univ., College Park. Dept. of Agricultural Engineering.
Harry J. Eby.
ASAE Paper No 61-935. Agricultural Engineering Journal, Vol 43, p 698-701, 714-715, Dec 1962. 6 fig, 1 tab, 19 ref.

Descriptors: *Farm lagoons, *Design criteria, Water temperature, Sewage treatment, Aerobic bacteria, Aquatic plants, Anaerobic bacteria, Algae, Biochemical oxygen demand, Oxidation lagoons, Sludge, Photosynthetic oxygen, Farm wastes, Waste water treatment.
Identifiers: *Site selection, Loading.

Criteria to be considered when designing a lagoon for treatment of wastes produced by animals in confinement is discussed. It mentions situations where lagoons would not be feasible. Seven criteria for site selection are given. The physical, chemical and biological factors discussed include temperature, light, specific gravity, mixing, nutritional effects, pH effects, toxic effects, and interrelationship of biological species. Also mentioned is the algal-bacterial relationship. Design factors for size and volume are given. The article concludes with management problems encountered such as floating debris, overloading, intermittent loading, aquatic weeds and sludge build-up. (Parker-Iowa State)

### 0500-A6, B2, C1, C2, D3

**ANAEROBIC LAGOONS: CONSIDERATIONS IN DESIGN AND APPLICATION,**
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
Transactions of the American Society of Agricultural Engineers, Vol 11, p 320-322 and 330, 1968. 2 fig, 4 tab, 14 ref.

Descriptors: *Farm lagoons, *Anaerobic digestion, *Design, *Solids, Anaerobic conditions, Farm wastes, Temperature, Gases, Biochemical oxygen demand, Waste water treatment.
Identifiers: *Solids removal, Loading, Gas production, effluent quality.

Design and application of anaerobic lagoons for treatment of wastes from farm animals in confinement is described. The purpose for anaerobic lagoons is given in relation to aerobic lagoons and other treatment systems. The article proceeds to discuss size requirements, loading restrictions and mixing, both natural and mechanical as required. Quantities and quality of gas production are discussed as well as temperature relationships to gas production and other operating conditions. A short analysis of effluent quality is presented. Solids removal is discussed in some length. The article concludes by mentioning some difficulties such as potent effluent, warm temperature requirements and odors due to biochemical imbalance. (Parker-Iowa State)

### 0501-A10, B3, C1, C2, D3

**INVESTIGATIONS ON FLY CONTROL BY COMPOSTING POULTRY MANURES,**
Orange County Health Department, Santa Ana, Calif.
Roy E. Eastwood, Jimmy M. Kade, Robert B. Schoenburg, and Harold W. Brydon.
Journal of Economic Entomology, Vol 60, No 1, p 88-98, Feb 1967. 7 fig, 7 tab, 5 ref.

Descriptors: *Farm wastes, *Poultry, Aerobic conditions, Temperature, Degradation, Decomposing organic matter, Aeration, Mixing, Larvae, Bulk density, Volume, Moisture content, Nitrogen.
Identifiers: *Composting, Fly problems, Fly pupae, Windrows.

Windrow composting of poultry manure was investigated during several months of the year. Results obtained indicated that manure does not have to be ground prior to composting. Bulking and drying materials are not required in composting poultry manure. Fly larvae were reduced in numbers during the composting process so that they would not create a fly problem. Poultry manure once composted is not suitable as an oviposition site for adult flies and the subsequent development of larvae. A twice-weekly turning schedule with a manure spreader is desirable to help prevent fly larvae from pupating and emerging by bringing them into contact with the hot interior of the pile. (White-Iowa State)

### 0502-C1, C2,

**MANURE PRODUCTION BY BROILERS,**
Maine Univ., Orono. Dept. of Animal Science.
R. W. Gerry.
Poultry Science, Vol 47, p 339-340, 1968. 2 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, Feeds, Moisture content, Calcium, Phosphorus, Proteins.
Identifiers: *Manure production, Poultry litter, Broilers, Dry droppings, Wood shavings, Crude protein.

A test was conducted in which White Mountain x White Rock cross broiler were reared to 53 days of age and fed a modified New England College Conference starting ration. Actual production of dry matter which did not include the bedding or the moisture in the litter was 867 kilograms per 1000 males, 658 kilograms per 1000 females, and 748 kilograms per 1000 mixed sexes. The average amount of manure (litter) removed at the end of the test period was 1602 kilograms per 1000 birds. This litter included an average of about 500 kilograms of wood shavings per 1000 birds and analyzed 23 percent moisture. During the test period there was a marked increase in crude protein, calcium and phosphorus content of the litter. (White-Iowa State)

### 0503-C1, C2, C3

**THE MICROBIOLOGY OF BUILT UP POULTRY LITTER,**
Edinburgh Univ. (Scotland). Dept. of Bacteriology.
Henrietta Schefferle.
Journal Applied Bacteriology, Vol 28, No 3, p 403-411, 1965. 5 tab, 7 ref.

Descriptors: *Microbiology, *Bacteria, Farm wastes, Poultry, Odor, Fungi, Aerobic conditions, Laboratory tests, Alkalinity, Enteric bacteria, Lac-

tobacillus, Hydrogen ion concentration, Temperature, Moisture content.
Identifiers: Litter, Coryneform bacteria, Enterococci.

The numbers of viable bacteria in built up poultry litter were found to be 10 to the 10th power - 10 to the 11th power/g fresh weight and appeared to be little affected by factors such as age, temperature, moisture content and pH. Counts for unused litter and poultry droppings were lower. In built up litter of high alkalinity coryneform bacteria were predominant; micrococci occurred sporadically and small numbers of nocardias, streptomycetes, aerobic spore formers and streptococci were encountered. A variety of Gram negative bacteria also occurred, the numbers of which appeared to be controlled by alkalinity; they were less abundant in litters where the pH and buffering capacity were high. Strongly alkaline conditions also tended to lower the fungal counts but had no effect on the count of enterococci. (Christenbury-Iowa State)

### 0504-B3, C2, D1, D2, F1.
**COST OF DEHYDRATING POULTRY MANURE.**

Poultry Digest, p 143, Mar 1971.

Descriptors: *Farm wastes, *Dehydration, *Costs, Poultry, Equipment, Fertilizers, *Waste treatment.
Identifiers: Shelf life.

Conventional dehydrating equipment is available for drying poultry manure. However, the cost of the processed manure is likely to exceed $20 per ton. A two-stage drying process has been developed that brings the cost down to $7.60 per ton for a product with 10% moisture. The final product is a fine powder, free of offensive odors, has shelf life and it has the qualities required for sale as an organic fertilizer. It contains 4 to 5% nitrogen, 3% phosphoric acid, and 2.5% potash. (Christenbury-Iowa State)

### 0505-B1
**CONFINEMENT REARING OF TURKEYS,**
Amerine National Corp., Oakdale, Calif. Hastings Div.
Douglas C. Ferebee.
Poultry Digest, p 110-112, Mar 1971. 2 fig.

Descriptors: *Ventilation, *Management, *Confinement pens, Farm wastes, Equipment, Hazards, Poultry, Water pollution control.
Identifiers: *Psychrometric chart, Overventilation, Turkeys.

Some management functions that can lead to maximizing returns from turkey production are discussed. To get the most out of any ventilation system, whether it is positive or negative pressure, knowledge of psychrometrics by the person doing the ventilating is essential. It is possible to overventilate a total confinement house or to underventilate it. Much can be gained from having thermostats located outside where outdoor conditions can be used to provide a better environment inside. Good, not necessarily new, in-house equipment is vital for optimum results from confinement production. (Christenbury-Iowa State)

### 0506-A2, C1, C2, C3
**CATTLE FEEDLOT RUNOFF - ITS NATURE AND VARIATION,**
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
J. R. Miner, R. I. Lipper, L. R. Fina, and J. W. Funk.
Journal Water Pollution Control Federation, Vol 38, p 1582-1591, 1966. 8 fig, 11 tab, 12 ref.

Descriptors: *Farm wastes, *Runoff, *Bacteria, Cattle, Simulated rainfall, Hydrographs, Chemical oxygen demand, Biochemical oxygen demand, Nitrogen, Temperature, Pollutants, Water pollution sources.
Identifiers: Kjeldahl nitrogen, Feedlot runoff, Suspended solids, Chemical quality, Most probable number.

Runoff from cattle feedlots is a high-strength organic waste produced during and immediately after rainfall. These studies indicated that greatest pollutant concentrations are obtained during warm weather, during periods of low rainfall intensity, and when the manure has been made soluble by soaking with water. Correlations were developed to predict runoff oxygen demand and nitrogen content based on these factors. In addition, the following points were demonstrated: (1) Feedlot runoff is a source of high concentrations of bacteria normally considered as indices of sanitary quality, and (2) runoff from a concrete-surfaced lot was more heavily polluted than that from a nonsurfaced lot under similar conditions. (Christenbury-Iowa State)

### 0507-A1
**ANIMAL WASTES,**
Guelph Univ. (Ontario). Dept. of Soil Science.
L. R. Webber.
Journal of Soil and Water Conservation. Vol 26, No 2, p 47-50, Mar-Apr 1971. 21 ref.

Descriptors: *Farm wastes, *Disposal, Pollutants, Pollution abatement, Groundwater, Farm lagoons, Treatment, Anaerobic digestion, Aerobic treatment, Management, Water pollution sources.
Identifiers: Contamination, Feedlots, Waste removal, Composting.

Some waste management problems resulting from high-density confinement of livestock are discussed. Treatment and disposal of the waste material causes the most troublesome problems. There are many systems in use, with anaerobic or aerobic lagoon treatment more common. Man has always used land as the ultimate disposal medium for many kinds of waste. Agriculture finds itself in the challenging position of being able to use or dispose of vast quantities of animal wastes without polluting the water, soil, or air. (Christenbury-Iowa State)

### 0508-A4, A5, A7, A8, D3, E2
**AIR POLLUTION FROM ANIMAL WASTES,**
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
William E. Burnett.
Environmental Science and Technology, Vol 3, No 8, p 744-749, Aug 1969. 6 fig, 2 tab, 21 ref. N.Y. State Dept. of Health C-1101 USDA, ARS 12-14-100-9092 (44).

Descriptors: *Farm wastes, *Pollutant identification, *Odor, Air pollution, Gas chromatography, Organic compounds, Organic acids, Aromatic compounds, Poultry, Laboratory tests.
Identifiers: *Malodor, *Odorous compounds, *Odor identification, Liquid poultry manure.

A combination of gas chromatographic and organoleptic techniques was used to determine the chemical compounds responsible for the offensive odor of accumulated liquid poultry manure. The volatile odorous substances were trapped and concentrated in short sections of gas chromatographic columns held at -78C., separated by gas chromatography and identified by the correspondence between relative retention time and the odors of the peaks for the unknowns and authentic compounds. Mercaptans, sulfides, and diketones were identified. Volatile organic acids and the nitrogen heterocycles, indole and skatole, were also identified, using direct injections of liquid manure supernatant and standard gas chromatographic techniques. The sulfur compounds, organic acids, and skatole were implicated as important malodorous components involved in air pollution. The prevention of the formation of the malodorous substances was suggested as the best means of control of air pollution from animal wastes. (Hazen-Iowa State)

### 0509-A6, A7, B2, C2
**THE METAL COMPLEXING CAPACITY AND THE NATURE OF THE CHELATING LIGANDS OF WATER EXTRACT OF POULTRY LITTER,**
Georgia, Univ., Athens. Dept. of Agronomy.
K. H. Tan, R. A. Leonard, A. R. Bertrand, and S. R. Wilkinson.
Georgia Agr. Exp. Sta. Journal Series Paper No. 760. Soil Science Society of American Proceedings, Vol 35, No 2, p 265-269, Mar 1971. 3 fig, 1 tab, 23 ref.

Descriptors: *Farm wastes, *Organic matter, *Organic wastes, *Infrared radiation, Chelation, Analytical techniques, Chemical reactions, Laboratory tests.
Identifiers: *Poultry litter, *Infrared identification, Infrared analysis, Organic waste products, Complexing agents, Chelating ligands.

The metal complexing capacity and the nature of the chelating legands of organic matter extracted from broiled house litter were studied by ion-exchange equilibrium and dissolution methods and infrared to exhibit a significant chelating effect on the equations Cu2.., Zn2.., Mg2.., and Al3... The amount of organic matter complexed by one mole of metal and the stability of metal complexes increased with increasing pH in the cases of Cu-, Mg- and Al- complexes. Infrared analysis revealed spectograms of the ligands similar to those obtained by polysaccharides. Functional group frequency vibration comparisons at 3,500, 3,200, 1,650, and 1,400 cm-1 showed that the formation of stable metal complexes involved carboxyc electrovalent linkages and probably hydroxyl and/or amino coordinate linkages. (Hazen-Iowa State)

### 0510-C2, F6
**CATTLE, SWINE AND CHICKEN MANURE CHALLENGES WASTE DISPOSAL METHODS,**
Connecticut Univ., Storrs.
R. Laak.
Water and Sewage Works, Vol 117, No 4, p 134-138, April 1970. 8 tab, 30 ref.

Descriptors: *Agriculture, *Cattle, Waste water (Pollution), Costs, Nitrogen, Phosphorous, Potash, Fertilizers, Disposal, Pollution, Livestock, *Hogs, Poultry, Nitrogen compounds, Phosphorus compounds, *Farm wastes.
Identifiers: Chicken, Feedlots.

In the United States today approximately 0.66 billion lbs per day of manure must be extensively treated or destroyed. The trends in agriculture indicate that more livestock will be confined in the future, the concentration of the wastes increased, and the volume of manure per animal slowly reduced. Extensive data was collected and is presented giving the general characteristics of feces and urine of cattle, swine, and poultry as well as the quantitative consumption of feed, nitrogen, phosphorous, and potash. The manure characteristics are said to be changing and therefore the treatment process principles must also be changed. Costs and land requirements are given for manure disposal and an extensive outline enumerates the large variety of available disposal methods along with each one's particular drawback. The average cost of manure separation and final disposal must be a fraction of $3 to $40 per ton. (Hancuff-Texas)

### 0511-A9, A11, B1, C1, C2 C3, E3
**ANIMAL WASTE REUSE--NUTRITIVE VALUE AND POTENTIAL PROBLEMS FROM FEED ADDITIVES--A REVIEW.**

Agricultural Research Service, Beltsville, Md. Animal Science Research.

ARS 44-244, Feb 1971. 56 p, 3 tab, 184 ref.

Descriptors: *Farm wastes, *Additives, *Feeds, Ruminants, Poultry, Cattle, Diets, Hazards, Hogs, Biodegradation, Pathogenic bacteria, Larvicides, Pest control, Organophosphorus, Nutrients.
Identifiers: *Literature review, *Residues, Swine, Hormones, Antibiotics, Disease control, Growth adjuvants, Excretion data, Registration, Non-nutritive.

This is a report of literature on the nutritional value of animal wastes and the potential problems that may occur when compounds other than nutrients are added to animal feed. The non-nutritive feed additives discussed are as follows: Pellet binders, flavoring agents, enzymes; Antibiotics, arsenicals, nitrofurans, (low level feeding); Antifungals, larvicides; Broad-spectrum, absorbable antibiotics (high level therapeutic use); Chemicals used to potentiate curative properties of antibiotics; Coccidiostats, worming drugs, antioxidants; Carotenoid sources, hormones; Reserpine, aspirin, and tranquilizing drugs. (White-Iowa State)

## 0512-A4, A5, A7, A8, A11

**FECAL RESIDUES FROM FEED ADDITIVES--POULTRY,**
Agricultural Research Service, Beltsville, Md. Animal Science Research.
C. C. Calvert.
In: Animal Waste Reuse--Nutritive Value and Potential Problems from Feed Additives--A Review. ARS 44-224, p 14-19, Feb 1971.

Descriptors: *Additives, *Feeds, *Poultry, Farm wastes, Pollutants, Diets, Hazards, Water pollution.
Identifiers: Antibiotics, Arsenicals, Nitrofurans, Growth adjuvants, Soil pollution.

To keep pace with the increased demand for eggs and poultry meat, the feed manufacturers and producers have used more and more feed additives. There is a concern with what these additives may contribute to air, soil, and water pollution after they have performed whatever function they may have in the animal body. The nonnutritive feed additives commonly found in poultry feed are discussed. These include pellet binders, flavoring agents, enzymes, antibiotics, arsenicals, and nitrofurans; antifungal agents, coccidiostats and worming drugs, antioxidants, carotenoid sources, hormones, reserpine, aspirin and tranquilizing drugs are being added to poultry feeds. (See also (Christenbury-Iowa State)

## 0513-A8, A11

**FECAL RESIDUES FROM FEED ADDITIVES--SWINE,**
Agricultural Research Service, Beltsville, Md. Animal Science Research.
L. T. Frobish.
In: Animal Waste Reuse--Nutritive Value and Potential Problems from Feed Additives--A Review. ARS 44-224, p 19-27, Feb 1971.

Descriptors: *Additives, *Hogs, *Feeds, Farm wastes, Hazards, Pollutants, Growth rates, Diets.
Identifiers: Swine, Diethylstilbestrol.

This paper discusses the major feed additives associated with swine production. They are: antibiotics, arsenicals, copper, nitrofurans, sulfonamides and hormones. Many compounds have been used for the treatment of specific diseases in swine but when incorporated into the diet at low levels may have growth promoting properties. There is little available information on the metabolites of antibiotic degradation, their excretion, and possible distribution in the soil and finally into plants. Arsanilic acid is the most common arsenical compound used in swine diets. There is very limited data on excretion of many of the additives and their subsequent effect on the environment.
(Christenbury-Iowa State)

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## 0514-A8, A11, A12

**FECAL RESIDUES FROM HORMONES AND ANTIBIOTICS--BEEF CATTLE,**
Agricultural Research Service, Beltsville, Md. Animal Science Research.
D. A. Dinius.
In: Animal Waste Reuse--Nutritive Value and Potential Problems from Feed Additives--A Review. ARS 44-224, p 27-32, Feb 1971.

Descriptors: Farm wastes, Cattle, Feeds, Diets, Degradation (Decomposition), Biodegradation.
Identifiers: *Hormones, *Antibiotics, Disease control, Concentrations, Implant, Excretion data.

The interest in hormones excreted by animals which may be recycled through plants and back to man or animals is with the natural and synthetic estrogens, androgens, and progestins. This discussion deals only with these. Other hormones, such as follicle stimulating hormone and luteinizing hormone, may be present in animal excreta but they occur in small concentrations and are readily biodegradable; thus, they are of little ecological concern. Certain antibiotics are frequently added to the high-grain ratios commonly fed to finishing beef cattle. A review summarizing some of the research that has been conducted with these antibiotics, particularly in reference to the potential for recycling through feedstuffs is presented. Plants will not absorb from the soil measurable quantities of the antibiotics commonly fed to cattle.
(Christenbury-Iowa State)

## 0515-A9, A10, A11, D2

**FECAL RESIDUES FROM LARVICIDES--POULTRY AND CATTLE,**
Agricultural Research Service, Beltsville, Md. Animal Science Research.
R. W. Miller.
Also in Bulletin of the Entomological Society of America as Larvicides for Fly Control - A Review, by R. W. Miller, Vol 16, No 3, p 154-158, Sept 1970. In: Animal Waste Reuse--Nutritive Value and Potential Problems from Feed Additives--A Review. ARS 44-224, p 33-41, Feb 1971. 2 tab.

Descriptors: *Farm wastes, *Larvicides, Larvae, Pathogenic bacteria, Boron, Organophosphorus, Pesticides, Cattle, Poultry, Feeds, Pesticide residues, Pest control.
Identifiers: Fly larvae, Feed additives, Residues, Fly control, Animal manures, Registration.

One of the best methods for control of flies is through the use of larvicides, applied either directly to the manure, or as a feed additive. Research was conducted as early as 1928 on feed additives to make the feces unfavorable for the development of horn fly larvae. In 1954, organophosphorus insecticides began receiving a great deal of attention as possible feed-additive larvicides for the control of flies around both poultry and cattle operations. Although a great deal of research has been conducted on find suitable feed-additive larvicides for fly control around poultry and cattle manure, no insecticides are registered for commercial feed-additive use with poultry and only one has a registration for use with lactating dairy cattle. Three insecticides have registrations for feed-additive use with beef cattle. (Christenbury- Iowa State)

## 0516-A4, A5, A7, A8, F3, F4

**PROCEEDINGS OF FARM ANIMAL WASTE AND BY-PRODUCT MANAGEMENT CONFERENCE.**
Wisconsin Univ., Madison.
University Extension, The University of Wisconsin, November 6-7, 1969. 129 p.

Descriptors: *Farm wastes, *Cattle, *Hogs, *Poultry, *Environment, Social aspects, Economic, Political aspects, Psychological aspects, Air pollution, Water pollution, Soil contamination.
Identifiers: *Management conference.

This conference was held for technical and administrative staff of local, state, regional and federal agencies; for industries and for private citizens who are concerned about or have a responsibility related to the proper management of wastes from farm animal enterprises in Wisconsin. It was an introductory meeting at which the dimensions of the problems were examined, research was reviewed, some alternative manure handling methods were highlighted, public agency roles were outlined and two existing local programs were described. Small group discussions explored future program and research needs. (White-Iowa State)

## 0517-A4, A5, B3, C2, E2, F1

**QUANTITIES AND CHARACTERISTICS OF FARM-ANIMAL WASTES,**
Public Health Service, Chicago, Ill. Bureau of Solid Waste Management.
Ralph J. Black, and William Q. Kehr.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 17-21. 3 tab, 6 ref.

Descriptors: *Farm wastes, *Water pollution, Population, Pollution abatement, Confinement pens, California, Solid wastes, Dissolved oxygen, Water quality, Hogs, Cattle, Poultry, Nutrients, Sewage sludge.
Identifiers: Meat consumption, Livestock production, Population equivalent, Land disposal.

The paper points out that an increased population will require much more beef and poultry, thus increasing the agricultural waste problem. Confinement feeding is firmly established, and, while the number of feeding operations is expected to decline, the total production will be increased. The importance of agricultural wastes is brought out in a table showing quantities of solid wastes generated in California. This is magnified by population equivalent data which states that animal wastes were equivalent in pollutional affect to 10 times that of the nation's population. Data is presented on quantities produced and the nutrient value of animal wastes. It is economically unfeasible to utilize this waste for its fertilizer value. The quantity of animal wastes will increase, as will the management problems associated with its handling, treatment and disposal. (White-Iowa State)

## 0518-A4, A5, A8, A12, C3, E2

**HEALTH PROBLEMS,**
Wisconsin Univ., Madison. Dept. of Bacteriology.
Elizabeth McCoy.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 22-24.

Descriptors: *Public health, *Farm wastes, *Bacteria, Water pollution, Soil contamination, Coliforms, E. Coli, Streptococcus, Soil, Loam, Rates of application, Sampling, Cores, Adsorption, Percolation.
Identifiers: *Enterocci, Miami silt loam, Die-off.

Animal wastes contain enormous amounts of pollution bacteria. If it finds its way to surface or well waters the water would be reported as 'contaminated.' Bacterial counts made on fresh feces gave the following values: Coliform, 100,000 - 1,000,000/gm.; Enterococci, 1,000,000 - 10,000,000/gm. Experiments were done to trace pollution bacteria in manure applied to soil. Five gallon pails (with bottoms cut out) were set to about three-fourths of their depth in a field of Miami silt loam. Applications of a manure/water slurry were made in 15, 30, and 80 tons per acre amounts. Both types of bacteria were adsorbed with S98..% removal by 14 inches. The soil acts as a very efficient filter. (White- Iowa State)

### 0519-A5, A10

**AESTHETICS AND ODORS,**
Wisconsin Dept. of Natural Resources, Madison.
Douglas Evans.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 25-26.

Descriptors: *Farm wastes, *Odors, Aesthetics, Anaerobic conditions, Hydrogen sulfide.
Identifiers: *Odor threshold, Public nuisance, Odor panel, Odor measurement.

The difficulty of evaluating the offensiveness of odors is their subjective nature. Odors from farm animal wastes, particularly anaerobicclly generated are, in general, offensive, but the substances involved and the thresholds of detection are little known. Typical odor thresholds are given when determined by a trained panel. A method is outlined for eliminating panel members insensitive to odors. More needs to be known about the type, quantity and odor threshold of the various compounds involved in farm animal wastes. From this better methods of treating, storing, handling and disposing of wastes may be developed which will reduce or eliminate the odor problem.
(White-Iowa State)

### 0520-A4, A11, B1, E1, F1, F2

**DEAD ANIMALS AND HOW THEY CONTRIBUTE TO POLLUTION OF THE ENVIRONMENT,**
Department of Agriculture, Madison, Wis.
A. A. Erdmann.
In: Proceedings of Farm Animal Waste and By-Product Management Conference,.University Extension, University of Wisconsin, November 6-7, 1969, p 27-29.

Descriptors: Transportation, Costs, Livestock, Legislation, Water pollution, Environment, Wisconsin.
Identifiers: *Dead animal disposal, *Rendering plants, Slaughter plant scraps, Carcasses.

The article describes why dead animals are fast becoming a pollution problem. Where once rendering plants paid to pick up dead animals they now charge livestock owners a fee for pick-up and disposal of livestock losses. The number of dead animals being sent to rendering plants has decreased by about 50%. Some legislation concerning the problem is encouraging. The author expects the problem of dead animal disposal to increase in the future. The problems of the rendering plant industry, such as added labor costs, collection costs, and, perhaps most important, the inferior product resulting from such operations, will probably make it necessary to use a different method of disposal of dead animals than is now followed.
(White-Iowa State)

### 0521-A3, C3

**WATER QUALITY PROBLEMS,**
Wisconsin Dept. of Natural Resources, Madison.
F. H. Schraufnagel.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 30-32 November 6-7, 1969. 7 ref.

Descriptors: *Water quality, *Farm wastes, Water pollution sources, Fishkill, Fish, Dissolved oxygen, Nutrients, Nitrogen, Nitrates, Phosphorus, Eutrophication, Base flow, Ammonia, Coliforms, Cattle, Wisconsin.
Identifiers: *Land disposal, Concentrations, Feedlots.

Probably the biggest concern in Wisconsin about pollution from farm animal wastes is because of their nutrients. Nitrogen and phosphorus are the two significant nutrients causing eutrophication in lakes and streams. Land disposal is usually an effective way to prevent pollution except when wastes are applied to frozen ground. Data from the nutrient content of base flows generally indicates that percolation through the ground eliminates most of the phosphorus and nitrogen. The potential for pollution from animal wastes is very great. The likelihood of pollution from cattle will increase with manure fluidization and water carriage systems. The maintenance of water quality depends on research and development of techniques to control the problem. (White- Iowa State)

### 0522-A6, B3

**FUTURE TRENDS IN LIVESTOCK PRODUCTION,**
Wisconsin Univ., Madison. Coll. of Agriculture.
Robert W. Bray.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 33-35, November 6-7, 1969.

Descriptors: *Farm wastes, *Livestock, Cattle, Poultry, Hogs, Automation, Confinement pens, Odors, Waste disposal.
Identifiers: *Livestock numbers, Dairy cattle, Beef cattle, Feedlots, Horses, Waste management.

The author summarizes the article by saying that (1) livestock numbers will increase in the future and (2) the most economical management systems for all classes of livestock will result in larger numbers and more confinement in each livestock enterprise. Thus, the solid waste management or disposal problems associated with livestock production in Wisconsin will become more complex. The author gives his ideas as to what changes in production can be expected for dairy, beef, swine, poultry, and other operations.
(White-Iowa State)

### 0523-A1, B1, F4

**WHAT AND WHERE ARE THE CRITICAL SITUATIONS WITH FARM ANIMAL WASTES AND BY-PRODUCTS IN WISCONSIN,**
Wisconsin Univ., Madison.
M. T. Beatty, J. E. Kerrigan, and W. K. Porter.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 36-57, November 6-7, 1969. 4 tab, 12 fig.

Descriptors: *Farm wastes, *Wisconsin, *Spatial distribution, Environment, Soils, Surface waters, Groundwater, Land resources, Livestock, Cattle, Hogs, Poultry, Population, Geology, Hydrology, Precipitation, Standards, Water quality, Nitrogen, Nitrates, Odor, Watersheds, Bedrock.
Identifiers: *By-products, Earth resources, Soil associations, Critical situations.

Where and to what extent various kinds of critical situations develop, depends on the interaction of several components of the waste production and management system. These include: the kinds and amounts of wastes and by-products produced; the spatial distribution of the sources; the proximity to people; the physical environment- characteristics of the soils, the landscape, the surface water and groundwater systems, and; the uses and demands on water and land resources. Numerous tables and charts point up the importance of these components. Seven critical situations, the problems and locations involved, are then explained. They include livestock concentrations near urban areas,

### 0524-A6, B2, B3, D2, D3, E2, E3

**CONSIDERATIONS IN SELECTING DAIRY MANURE DISPOSAL SYSTEMS,**
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
O. I. Berge, E. G. Bruns, T. J. Brevik, and L. A. Brooks.
In: Proceedings of the Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 58-69, November 6-7, 1969. 10 tab, 1 fig, 1 ref.

Descriptors: *Farm wastes, *Cattle, Labor, Odor, Investment, Storage, Storage tanks, Annual costs, Value, Nitrogen, Phosphorus, Potassium, Urine, Equipment, Wisconsin.
Identifiers: *Dairy cattle, *Manure disposal systems, Hauling, Stacking, Manure handling.

Different methods of handling dairy manure and disposing of it are discussed. Advantages and disadvantages are listed. The three basic systems include daily hauling, stacking, and liquid manure storage. Investment and annual costs are compared for the three systems under similar stanchion and free stall housing operations. Dairy manure is valued at $1.40/ton for its nutrient content. Various types of handling equipment are discussed as well as a few disposal methods. (White- Iowa State)

### 0525-A6, B2, B3, D2, D3, E2, E3

**ENGINEERING RESEARCH ON FARM ANIMAL MANURE,**
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
Clyde Barth.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 70-79, November 6-7, 1969. 2 tab, 6 ref.

Descriptors: *Farm wastes, *Biological treatment, Disposal, Livestock, Anaerobic digestion, Waste storage, Lagoons, Aerobic treatment, Waste dilution, Temperature, Rotors, Irrigation, Odor, Gases.
Identifiers: *Waste management, Waste characteristics, Anaerobic lagoon, Aerobic lagoon, Oxidation ditch, Composting, BOD removal, Land application, Coprophagy, Chemical treatment, Solid-manure waste.

The article reviews different treatment and disposal methods which are currently being used or investigated. Anaerobic and aerobic lagoons are used but are limited by temperature and odor problems. The oxidation ditch can be used for swine but its use is uncertain for wastes from other livestock. Composting, though effective, lacks a market for its finished product. Land application continues to be the most widely used type of livestock waste disposal. Irrigation and plow-furrow-cover applications are a modification of land disposal. Chemical treatment, dehydration, incineration, and coprophagy are being studied, but no conclusions have been drawn. Odor and gas production are problems not well understood and difficult to control. Solid manure, because of the lack of problems associated with its handling, deserves serious consideration in any animal waste handling situation.
(White-Iowa State)

### 0526-A4, A5, A7, A8, B1, E4, F5, F6

**NATION-WIDE RESEARCH ON ANIMAL WASTE DISPOSAL,**
Federal Water Pollution Control Administration, Chicago, Ill. Lake Michigan Basin Office.
Jacob O. Dumelle.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Ex-

tension, University of Wisconsin, p 80-81, November 6-7, 1969.

Descriptors: *Farm wastes, *Research and development, Grants, Algae, Air pollution, Water pollution, Soil contamination, Nutrients.
Identifiers: *FWPCA, Activated algae, Feedlots, Oxidation ditch.

The article gives brief descriptions of research projects which the Federal Water Pollution Control Administration is helping to fund. One such project under way in California is trying to determine the practicability of producing and harvesting algae to remove nutrients from agricultural drainage waters. Other projects involve cattle feedlot runoff, and dairy waste waters. Besides research on treatment methods, some projects are trying to find out how much nutrient runs off, and how much gets into water. (White-Iowa State)

### 0527-A4, A5, F2, F6

**WATER RESOURCES CENTER RESEARCH ON ANIMAL WASTES AND WATER QUALITY,**
Wisconsin Univ., Madison. Water Resources Center.
J. E. Kerrigan.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 82-85, November 6-7, 1969.

Descriptors: *Farm wastes, *Water quality, Eutrophication, Research and development, Wisconsin, Legislation, Water resources, Environment, Resources.
Identifiers: *Water Resources Center, Water research.

The function and goals of the University of Wisconsin's Water Resources Center are pointed out. The Center got its start from faculty committees formed to study groundwater and subsequently lakes and streams. It was then assigned state responsibility by the legislature for the coordination and administration of an interagency water resources research and data collection program. Lists of objectives and functions of the Water Resources Center are given. If Wisconsin is to have a well balanced research program for water quality management, it is necessary to direct the limited available financial support to researchers with specially developed talents to solve specific problems that merit consideration. A generous amount of effort must be expended to identify the real problems. (White-Iowa State)

### 0528-A6,B1, F1

**THERE'S HOPE AHEAD,**
Wisconsin Univ., Madison. Dept. of Poultry Science.
John Skinner.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 86-90, November 6-7, 1969.

Descriptors: *Farm wastes, *Odor, Land use, Population, Management, Poultry, Foods, Agriculture.
Identifiers: Manure handling, Public relations, Goals, Land use planning.

Examples are cited of problems which have been turned into profitable industries; this can also be done with animal wastes. The increasing urban population will demand that animal wastes and their associated odors be disposed of at least cost to the meat consuming public. We must first dedicate ourselves to finding answers to the animal waste disposal problem. We must have full realization and appreciation of the cause, extent and consequences of the problem by all concerned. Better land use planning is needed as well as progressive regulations and laws. Better public relations must be created for all of agriculture and agriculturally related industries. Emphasis is placed on realizing the consequences of what we are doing today. The author proposes a goal of 'rendering inoffensive those parts of animal waste and by-products which are disagreeable to the public in general.' (White-Iowa State)

### 0529-A4, A5, A8, E1, F1

**INTRODUCTION TO FEDERAL, STATE AND LOCAL ACTION PROGRAMS TO SOLVE ANIMAL WASTE DISPOSAL PROBLEMS,**
Wisconsin Univ., Madison. Dept. of Agricultural Economics.
Douglas A. Yanggen.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 91, November 6-7, 1969.

Descriptors: *Farm wastes, Water pollution, Agriculture, Environment, Government supports, Cost sharing, Education, Regulation.
Identifiers: *Government programs, Technical assistance, Subsidy.

An introduction is given for following articles on governmental programs which include technical assistance, cost sharing, regulation and education at federal, state and local levels. Those included illustrate the various techniques for influencing private decision making. (White-Iowa State)

### 0530-A4, A5, F2, F6

**THE ROLE OF THE FEDERAL WATER POLLUTION CONTROL ADMINISTRATION IN FARM ANIMAL WASTE AND THE BY-PRODUCT MANAGEMENT,**
Federal Water Pollution Control Administration, Chicago, Ill. Great Lakes Region.
Frank E. Hall.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 92-95, November 6-7, 1969.

Descriptors: *Farm wastes, *Water pollution, Research and development, Federal government, Disposal, Grants, Water pollution control, Lake Erie, Water quality, Standards, Legislation.
Identifiers: *FWPCA, Animal waste disposal, Agricultural practices, Feedlots, Enforcement actions, Water quality standards.

A discussion is presented stating how the programs of the Federal Water Pollution Control Administration relate to farm animal wastes and by-product management. Examples are given of government and in-house research activities. Mention is given of those FWPCA supported activities that relate directly to the control of pollution from farm animals. These include pollution surveillance and water quality monitoring among others. The author feels that the most significant recent accomplishment in water pollution control is the establishment of water quality standards. (White-Iowa State)

### 0531-A3, B1, B4

**TECHNICAL ASSISTANCE AVAILABLE FROM THE SOIL CONSERVATION SERVICE,**
Soil Conservation Service, Madison, Wis.
Jack Densmore.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 96-97, November 6-7, 1969.

Descriptors: *Farm wastes, *Soil conservation, Surface runoff, Diversion, Grassed waterways, Terracing, Waste storage.
Identifiers: *Technical assistance, Soil Conservation Service, Farm waste disposal, Feedlot.

Situations in which technical assistance from the Soil Conservation Service (SCS) might be useful for reducing pollution from farm wastes are listed. Although the list is not all inclusive it gives an idea of assistance that can be obtained. An inventory and analysis of existing and potential areas where farm waste disposal may be a problem is needed. Technical assistance is available from the SCS to help on farm waste disposal problems, under the following limitations: (1) where the solutions involve techniques of soil and water conservation; (2) with the priorities established from time to time by local soil and water conservation district supervisors; and, (3) within the limitations of available man-power. (White-Iowa State)

### 0532-A4, A5, A8, E1, F1

**COST-SHARING UNDER THE AGRICULTURAL CONSERVATION PROGRAM,**
Agricultural Stabilization and Conservation Service, Madison, Wis.
Kenneth H. Hoover.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 98-100, November 6-7, 1969.

Descriptors: *Farm wastes, *Cost sharing, Pollution abatement, Soil conservation, Water conservation, Sedimentation.
Identifiers: ASCS, *Agriculture Conservation Program.

Practices and objectives of the Agricultural Conservation Program (ACP) have been broadened to include pollution abatement, provided such practices also result in soil and/or water conservation. The Agricultural Stabilization and Conservation Service (ASCS) manages program funds of the ACP. A list of components that ought to be included in pollution abatement cost-sharing practices is given. Most practices receive cost-sharing at 80% of cost. Farmer acceptance and financial contribution are needed to accomplish the stated objectives. (White-Iowa State)

### 0533-A4,A5, C2, F2

**THE REGULATORY ROLE OF THE DEPARTMENT OF NATURAL RESOURCES,**
Wisconsin Dept. of Natural Resources, Madison. Div. of Environmental Protection.
Thomas G. Frangos.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 101-104, November 6-7, 1969.

Descriptors: *Farm wastes, *Legislation, Water pollution, Pollution abatement, Wisconsin, Water quality, Regulation, Industrial wastes.
Identifiers: *Department of Natural Resources, Feedlots.

Statutes which point out the authority for Wisconsin water pollution abatement are cited. Other statutes are aimed at prevention and enforcement of sporadic discharges into streams. Based on these statutes, it is clear that the Wisconsin Department of Natural Resources has adequate authority to implement a program of pollution abatement aimed at any source of pollution. Difficulties in implementation include tradition, procedures, and lack of staff and funds. Any solution to the complex animal waste problem will involve a mix of programs, combining regulation, research, education, financial assistance, voluntary actions by landowners and possibly even tolerance on the part of the non-farm population. (White-Iowa State)

### 0534-A1, A4, A5, A6, A7, F2

**COLUMBIA COUNTY PROGRAM,**

Columbia County Office, Portage, Wis.
Joe Tuss.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 105-107, November 6-7, 1969.

Descriptors: *Farm wastes, *Nitrates, Water pollution, Air pollution, Odor, Pollution abatement, Zoning, Wells, Wisconsin.
Identifiers: Feedlots, Livestock concentration.

The Columbia County Extension Service was charged with formulating a 15 man farmer committee to study the present situation in view of pending proposed requirements of animal and agricultural waste disposal. It will make recommendations for preventing agricultural pollution in current problem areas and in expanding agricultural enterprises. A joint program by Columbia County Health Services, Zoning Administration and the University Extension formulated a project to sample well water for nitrates. Over 800 wells have been sampled. Forty-three percent of the high nitrate problem is on farms with high concentration of livestock. The public's demand for clean air, water and environment can be met by programs which involve the items of concern mentioned as well as others. (White-Iowa State)

### 0535-A4, A5, C2, F2

**WHAT ARE THE PROBLEMS IN WALWORTH COUNTY,**
Walworth County Zoning and Sanitation Office, Elkhorn, Wis.
James Johnson.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 108-110, November 6-7, 1969.

Descriptors: *Farm wastes, *Water pollution, *Zoning, Pollution abatement, Eutrophication, Nutrients, Water resources, Land use, Lakes, Urbanization, Education, Erosion control, Land development, Regulation, Wisconsin.
Identifiers: Problem areas, Soil capabilities, Feedlots, Regional Plan.

Increased urbanization resulting in land use conflicts is the overall problem in Walworth County, Wisconsin. As a result, the water resources are deteriorating at an alarming rate. Eutrophication, erosion and nutrient pollution are the major causes. The Regional Plan, properly implemented will regulate growth in such a way as to prevent many problems before they occur. The Walworth County Sanitary Ordinance was a pioneering effort in pollution control which regulated urban growth through the use of soil surveys. The Ordinance will implement zoning by defining 'County Conservation Standards'; which are all of the recommended conservation practices of the Soil Conservation Service. Much can be accomplished with local regulations, but education is essential to sell the program. (White-Iowa State)

### 0536-A4, A5, F2, F3, F6

**ROLE OF UNIVERSITY EXTENSION,**
Wisconsin Univ., Madison. Div. of Economic and Environmental Development.
Gale Vandeberg.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 111-113, November 6-7, 1969.

Descriptors: *Farm wastes, *Environment, Education, Universities, Research and development, Regulation, Water pollution, Wisconsin.
Identifiers: *University Extension, Adult education.

The challenge to Extension lies in the broad and continuous education of the public so that a pleasing and healthful environment may be maintained. The University Extension combined with the technical, financial and regulatory resources of other state and federal agencies has the resources to reduce the animal waste management problem. The University Extension staff has the responsibility to help various groups and the public to understand the problems and the alternatives; to help people who need to organize for action to do so, and to help groups and individuals to know what they can do, how to do it, and what resources are at their disposal. (White- Iowa)

### 0537-A1, F2, F3

**WHERE DO WE GO FROM HERE,**
Wisconsin Univ., Madison. Dept. of Meat and Animal Science.
Richard H. Vilstrup.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 114-115, November 6-7, 1969.

Descriptors: *Farm wastes, *Environment, Wisconsin, Technology, Education, Research and development, Regulation, Legislation.
Identifiers: Waste management, Waste utilization.

The author attempts to briefly summarize the ideas and presentations made at the conference. He points out that the waste management problem has many dimensions, including environmental, social, economic, physical, political and psychological. There is an increasing concern for the quality of environment in Wisconsin. As such, research and education are needed in many areas. Five specific recommendations for continued emphasis in the waste management area are made. Recommendations are also made for educational development. (White-Iowa State)

### 0538-A2, B2, B3, C1, C2, C3, F2

**CHARACTERISTICS OF WASTES FROM SOUTHWESTERN CATTLE FEEDLOTS.**
Texas Tech Univ., Lubbock. Water Resources Center.
Environmental Protection Agency, Water Pollution Control Research Series, January 1971. 87 p, 23 fig, 23 tab, 72 ref, 1 append. EPA Program 13040 DEM 01/71.

Descriptors: *Runoff, *Livestock, Quality control, Analysis, Cattle, Confinement pens, Feed lots, *Farm wastes, Southwest U.S., *Agricultural runoff, Solid wastes, Irrigation, Texas, Water reuse.
Identifiers: *Quality of runoff, *Lubbock (Tex).

Research was conducted on experimental feedlots in Lubbock, Texas, to determine the characteristics of wastes from Southwestern cattle feedlots. The feedlots were generally operated in a manner conforming to normal commercial practice in the area. They were provided with collection pits that allowed the quantity of runoff to be measured accurately. Samples of runoff were collected routinely both during rainstorms and from the collection pits. Manure samples were also collected routinely for analysis. The quantity of runoff per unit area of concrete-surfaced lots is substantially greater than the quantity per unit area of dirt-surfaced lots. Concentrations of pollutants in concrete-lot runoff are substantially higher than corresponding concentrations in runoff from dirt-surfaced lots. The quantity of solid waste derived from cattle fed an all-concentrate ration is less than half as great as the quantity derived from cattle fed a 12 percent roughage ration. Additional studies showed that all solid waste derived from cattle feeding operations are readily compostible, although the rate of composting is influenced to some extent by the type of ration, moisture content of the waste on the feedlot floor, and other factors. Agronomic studies indicate that runoff can be used for irrigation of crops, but extreme caution is required in the application of runoff to crops to prevent damage to them. (Dorland-Iowa State)

### 0539-A2, A4, A5, B1, B2, F2

**PROCEEDINGS OF ANIMAL WASTE MANAGEMENT CONFERENCE.**
Federal Water Pollution Control Administration, Kansas City, Mo.

Kansas City, Department of the Interior, February 1969. 40 p.

Descriptors: *Farm wastes, *Cattle, *Water pollution control.
Identifiers: *Feedlot pollution control, *State status reports, Animal production, Model feedlot regulation, Animal waste management.

An objective of the conference was to review the problem, as it exists today, of animal waste management. Information was given on how to conduct a state inventory of feedlots. A report was given on the Kansas animal waste control program. Control devices for animal feedlot runoff were discussed. The results of some feedlot pollution control research in Colorado and Nebraska was given. Status reports of 9 state pollution control programs were given, as well as model feedlot regulation design. (White-Iowa State)

### 0540-A4, A5, A8, A13, E2, F2

**INDUSTRY AND THE ENVIRONMENT FEEDLOT WASTE MANAGEMENT,**
Texas State Legislature, Austin.
W. Clayton.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February, 1969. p 5-7.

Descriptors: *Farm wastes, *Cattle, *Regulation, Pollution abatement, Ecosystems, Waste disposal, *Feed lots.

In assessing the significance of the various threats to our water and air resources, two items should be kept in mind: (1) no one can come to the environmental table with clean hands, and (2) a disproportionate emphasis placed on one segment of the problem may result in other areas going unnoticed. Animal waste in general and feedlot waste in particular pose significant environmental problems in the areas of (1) fish and other aquatic life and recreational uses, (2) potable water supplies and (3) land usage and esthetics. These environmental challenges can best be overcome by means of an effective and active alliance between the feeding industry and the responsible regulatory agency. (Schmitt-Iowa State)

### 0541-A2, A4, A6, A10, B2, E1, E2

**FEEDLOT POLLUTION SLIDE SHOW,**
Federal Water Pollution Control Administration, Kansas City, Mo. Missouri Basin Region.
R. S. Jessee.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 7-8.

Descriptors: *Farm wastes, *Runoff, *Fish-kill, Irrigation, Farm lagoons, Odor, Cattle, *Feed lots, Water pollution sources, Water pollution control, Iowa, Nebraska, Missouri River Basin.
Identifiers: Flies.

A major source of pollution in the Missouri Basin is agricultural waste from feedlots. There are over 46,000 feedlots in Iowa and over 24,000 in Nebraska. Over 4 million cattle were on feed last year in Iowa. The wastes generated by 100 cows are equivalent to 8 to 18 hundred people. Feedlot pollution too often occurs as a slug load washed into the stream after moderate or heavy rains.

Twenty-eight slides show extreme examples of water pollution from feedlots. They include slides taken at the John Redmond Reservoir, where over a half million fish were killed from cattle runoff. Several slides of manure in feedlots depict conditions before and after heavy rains. Also shown is a feedlot with a diversion terrace, a large lagoon, a secondary lagoon, and cropland irrigation; thus the nutrient cycle is completed.
(Schmitt-Iowa State)

## 0542-A2, A4, A5, F4

**ANIMAL WASTE POLLUTION - OVERVIEW OF THE PROBLEM,**
Federal Water Pollution Control Administration, Kansas City, Mo. Missouri Basin Region.
J. M. Rademacher.
In: Proceedings of Animal Waste Management Conferences, Kansas City, Missouri, February 1969. p 7-9, 4 ref.

Descriptors: *Farm wastes, *Groundwater, Cattle, Fish kill, Animal population, Runoff, Confinement pens, Waste treatment, Wells, *Feed lots, Missouri River Basin, Water pollution sources.
Identifiers: Population equivalents.

The volume of animal wastes produced in the United States is about ten times that produced by the human population. Two billion tons of livestock wastes are produced annually in the U.S.A. This amount of waste production is equivalent to that of a human population of 1.9 billion. There is evidence that animal wastes are a major source of water quality degradation. Feedlot runoff contaminates water supplies, destroys fish and aquatic life in streams, and generally degrades water quality. These wastes also have an effect on ground water, of 6000 water samples analyzed in Missouri, forty-two percent contained more than 5 parts per million nitrate as nitrogen. Public recognition and open discussions constitute a major step toward the solution to this major problem.
(Dorland-Iowa State)

## 0543-A2, A4, A5, E1, F1

**INDUSTRY'S ROLE IN FEEDLOT POLLUTION CONTROL,**
C. B. Joseph.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 9-10.

Descriptors: *Farm wastes, *Cattle, *Waste disposal, Runoff, Groundwater, Animal populations, Kansas, Economics, *Feed lots, Water pollution control, Water pollution sources, Industrial wastes.
Identifiers: Industrial expansion, Beef consumption.

In Kansas cattle in feedlots with over 1000-head capacity have increased in excess of 700% and are producing over half the state's total beef production. In 1956, of the 182,000 head produced, only 30,000 head were produced in commercial feedlots with a capacity in excess of 1000 head; however, by 1969, the total production had risen to 766,000 head of which 486,000 were produced in feedlots with over 1000-head capacity. With this rapid increase in both the size and number of large feedlots, the problems of pollution control have become more pressing. Sites for new feedlots must be chosen more carefully with respect to terrain features and tax write-off incentives need to be extended to feedlot owners to cover the cost of adequate control and disposal facilities.
(Dorland-Iowa State)

## 0544-A2, F1, F4

**HOW TO CONDUCT A STATE INVENTORY,**
Minnesota Pollution Control Agency, Minneapolis.
J. P. Badalich.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 11-12.

Descriptors: *Farm wastes, *Cattle, *Investigations, Runoff, Legislation, Minnesota, Waste disposal, Confinement pens, Financing, Permits, Topography, *Feed lots.
Identifiers: Inventory, Questionnaires.

The most important aspect of any feedlot inventory is the financing necessary to undertake such a project. Every government agency and private association is under a limited budget and the object of any study must be justified. Minnesota has 19,900 feedlots which makes personal investigations impractical and necessitate a canvas by mail. Some preliminary screening can be done by questionnaire which could be sent to households in rural areas. These questionnaires would not be applications for a permit, but would supply information on whether investigation for a permit would be necessary. These questionnaires would primarily determine the size of the operation, its location and topographical features, and the type of waste handling and disposal systems. Investigators could be sent where it was necessary and determine conformity to regulations and permits issued.
(Dorland-Iowa State)

## 0545-A4, F2

**HOW TO CONDUCT A STATE INVENTORY,**
Colorado Dept. of Health, Denver. Water Pollution Control Commission.
F. J. Rozich.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 12-14.

Descriptors: *Farm wastes, *Cattle, *Investigations, Runoff, Legislation, Colorado, Waste disposal, Confinement pens, Financing, *Feed lots.
Identifiers: Inventory.

With the passage of the Colorado Water Quality Act of 1966, the Colorado State Agency gained jurisdiction over wastes discharged by feedlots in the state. The first task was gathering more specific information, such as ownership, acreage involved in the various feedlots, the number of animals fed, and the location of the facility. To carry out the inventory an engineering technician was employed for field surveys. The Milk, Food, and Drug Section and local health units were asked to complete a similar inventory as part of their routine inspections of dairy cattle facilities. Where a possibility of water pollution was indicated, district engineers were asked to follow up and discuss this matter with the owner of the facility.
(Dorland-Iowa State)

## 0546-A2, A4, A5, A6, A10, B2, F2

**THE KANSAS ANIMAL WASTE CONTROL PROGRAM,**
Kansas State Dept. of Health, Topeka. Environmental Health Services.
J. L. Mayes.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 15-17, 1 append.

Descriptors: *Farm wastes, *Legislation, *Water quality control, Cattle, Investigations, Runoff, Kansas, Waste disposal, Permits, Fish kill, Odor, Retention, *Feed lots, Water pollution control.
Identifiers: Flies, Slug flow.

With the increasing size and number of cattle feedlots, the public has been aroused on the problems of odor and fly production. This concern was brought to the attention of the Kansas Department of Health where the concern shifted to water quality in 1959 when fish kills began occurring downstream from a few feedlots. Field investigation of water pollution episodes revealed that the 'slug' flow of animal waste runoff can seriously pollute receiving streams. These investigations allowed the design of a control program which will yield significant results. These regulations require containment and control by irrigation practices of all runoff from animal feedlot installations, with the minimum retention of three inches of surface runoff. A copy of these regulations is included.
(Dorland-Iowa State)

## 0547-A2, B2, B4, D3, E1, E2

**CONTROL DEVICES FOR ANIMAL FEEDLOT RUNOFF,**
Nebraska State Dept. of Health, Lincoln. Water Pollution Control Council.
T. O'Brien, and T. A. Filipi.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 18-19, 1 fig, 1 ref.

Descriptors: *Farm wastes, *Waste treatment, Confinement pens, Cattle, Aerobic treatment, Runoff, Farm lagoons, Irrigation, Waste disposal, Waste storage, *Waste water treatment, *Feed lots.
Identifiers: Anaerobic lagoons, Detention ponds.

The confinement feeding of livestock animals in large numbers has produced one of the most perplexing and complex problems ever faced by engineers, planners, and developers, not to mention the livestock feeder himself. The problem includes solid waste disposal, stream pollution, and air pollution. Basically, it involves the controlling of wastes from the animals in the confined feeding operations. Several types of control facilities are possible, detention ponds, anaerobic lagoons, aerobic lagoons, and oxidation ditches. A detention pond is intended to hold surface runoff from the feeding area and has the disadvantage of collecting large amounts of water which must be disposed of within a few days. Anaerobic lagoons work best when wastes are added at a constant rate which is difficult to maintain in a cattle feedlot. An aerobic system appears to be the most satisfactory with wastes scraped into hydraulically flushing gutters and emptied into variable aeration lagoons for treatment. (Dorland-Iowa State)

## 0548-A2, A3, A4, A5, A6, A7, A8

**RESEARCH ON ABATEMENT OF POLLUTION AND MANAGEMENT OF ORGANIC WASTES FROM CATTLE FEEDLOTS IN NORTHEASTERN COLORADO AND EASTERN NEBRASKA,**
Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
C. E. Evans.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 20-22, February 1969. 5 ref.

Descriptors: *Farm wastes, *Cattle, *Nitrates, Biochemical oxygen demand, Confinement pens, Runoff, Coliforms, Ammonia, Odor, Absorption, *Groundwater contamination, Water pollution sources, *Pollution abatement, *Organic wastes.
Identifiers: *Feed lots.

Livestock in the United States produce over 1 billion cubic yards of wastes per year. About three-fourths of our beef cattle are finished in feedlots. Some of these feedlots carry as many as 50,000 head, which presents a waste disposal problem similar to a city of 600,000 people. Rains are very efficient at picking up this material from feedlots, resulting in introduction of material with a high BOD into streams. Research was conducted to determine ground water pollution. Feedlots had the highest nitrate levels, but irrigated land probably contributes more total nitrate due to much larger acreage in irrigated land. There was a rapid die-off of the coliform population in feedlot soils, indicating little danger of ground water contamination by coliforms. Ammonia losses in the air

result in oder and increased ammonia absorption by water surfaces around the feedlot.
(Dorland-Iowa State)

### 0549-A2, F3

**THE UNIVERSITIES' ROLE IN FEEDLOT POLLUTION CONTROL,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. R. Miner.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 23-24, February 1969.

Descriptors: *Farm wastes, *Runoff, *Universities, Confinement pens, Cattle, *Pollution abatement, Research and development, *Feed lots.

Until feedlot runoff control is achieved in a manner acceptable to the livestock producer, regulatory agencies and the general public, the universities must play an active role. One of the principal contributions of universities toward solving the feedlot pollution problem is to guide and stimulate students through specific courses in livestock wastes combined with the basic principles of other scientific disciplines, such as civil and agricultural engineering, microbiology, chemistry, agronomy, and others. Extension education can be one effective method of alerting feedlot operators to the problems of feedlot runoff and bringing to them the currently available means of controlling or abating these problems. It also allows for feedback from feedlot operators to the university. A well-designed research project should, (1) be of interest to one or more researcher, (2) be compatible with available facilities, (3) stimulate growth on the part of the scientist and allow him to provide training to students, and (4) have some source of funding available. The roles of research centers and student training centers have been mutually beneficial. A university can interact with society through consultation of its staff with various individuals and agencies. Such interactions are possible because of the universities' reputation as an unbiased source of objective recommendations.
(Schmitt-Iowa State)

### 0550-A2, A4

**HOW TO GAIN PUBLIC SUPPORT,**
Kansas City Star, Mo.
R. Turnbull.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 24-25, February, 1969.

Descriptors: *Farm wastes, *Runoff, Pollution abatement, Cattle, *Feed lots.

On the pollution subject there are two extremes, one group would stop doing anything that might in any way pollute streams, such as use of commercial fertilizer; while the other extreme insists they will continue to do as they please. Between these extremes are those people, both cattlemen and the general public, who will be reasonable if they are given the facts. The facts in the situation of feedlot runoff pollution consist mainly of numbers. Although not so at one time, we now have so many cattle and other livestock in feedlots that we have a problem. We must realize the number of cattle on feed has doubled since 1950. These numbers as simply as anything define the problem, and are understandable to the public. When they do understand this, they will be better prepared to give public support for whatever is needed to solve the problem. (Schmitt-Iowa State)

### 0551-A1, F2

**MINNESOTA FEEDLOT POLLUTION CONTROL PROGRAM – STATUS REPORT,**
Minnesota Pollution Control Agency, Minneapolis.
J. P. Badalich.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 25-26, February 1969.

Descriptors: *Farm wastes, *Legislation, Administrative agencies, Legal aspects, *Regulation, *Minnesota, *Feed lots.

Following the Big Stone Lake study, a joint venture by the Governors of Minnesota and South Dakota, interest war generated in regulations regarding feedlot controls for the state as a whole. The Minnesota Pollution Control Agency is charged under statute for the control of all wastes. A 'preliminary draft' of regulations was published which caused criticism from many feeders and various organizations. These reports and comments should precipitate regulations that will be reasonable and desirable. We then go through the statutory procedure of public hearings, where we hope to get the reactions of the people in industry as well as the public at large. The next step is for the assistant attorney general to come up with the findings of fact, conclusions, and order. The Agency will then promulgate the standards, have them published, and issued. Following this we will set up specific rules, regulations and procedures, and then go into an inventory type procedure. Any regulation or standard proposed to the public or any industrial or municipal group must be reasonable, feasible, and practicable.
(Schmitt-Iowa State)

### 0552-A4, F2

**STATUS, PLANS, AND NEEDS FOR A COMPREHENSIVE FEEDLOT POLLUTION CONTROL PROGRAM IN SOUTH DAKOTA,**
South Dakota State Dept. of Health, Pierre. Water Pollution Control Section.
B. Barker.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 26, February, 1969.

Descriptors: *Farm wastes, *Regulation, *Administrative agencies, *South Dakota, Legislation, Pollution abatement, *Feed lots.

A provision for promulgation of regulations to control wastes associated with confined feeding of livestock was included in the Plan of Implementation of the 'Water Quality Standards for the Surface Waters of South Dakota.' The standards were adopted by the South Dakota Committee on Water Pollution on April 20, 1967 and by the Secretary of the U.S. Dept. of the Interior on August 7, 1967. In January, 1967, an Advisory Committee on the Committee on Water Pollution and the State Department of Health was formed to provide technical assistance in developing regulations. Proposed regulations were discussed at a public meeting in Pierre on December 9, 1968. The Committee on Water Pollution will review feedlot waste disposal information presented at the December meeting and will prepare a regulation for the purpose of holding public hearings. We are working with the South Dakota Water Resources Institute and Civil Engineering staff at South Dakota State University in developing a study on the effects of feedlot wastes on our surface waters. Plans include an education program to keep the industry informed of proposals and obtain feedback from the agricultural community. (Schmitt-Iowa State)

### 0553-A1, A4, A5, A7, F2

**STATUS REPORT OF MONTANA'S PROGRAM TO CONTROL POLLUTION FROM ANIMAL FEEDLOTS,**
Montana State Dept. of Health, Helena. Water Pollution Control Section.
D. Willems.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 27, February, 1969.

Descriptors: *Farm wastes, *Regulations, *Montana, Administrative agencies, Legislation, Pollution abatement, *Feed lots.

Montana does not have feedlot regulations but at this time is developing regulations. Most complaints on feedlots are because of nuisance conditions, thus, control of both air pollution and water pollution seems essential. Development of a permit system for feedlots, similar to the present system for municipal and industrial waste discharges is hoped for. The main concern at this time is to have adequate control of new feedlots and the prediction is that there will be many in the state before too long. It looks as though much time could be spent on controls for existing feedlots with very little accomplishment.
(Schmitt-Iowa State)

### 0554-A1, F2

**MISSOURI'S ANIMAL WASTE MANAGEMENT,**
Missouri Water Pollution Board, Jefferson City.
B. Crockett.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 27, February 1969.

Descriptors: *Farm wastes, *Regulation, *Missouri, Administrative agencies, Waste disposal, Pollution abatement, Cattle.

The Missouri Water Pollution Board believes the agricultural pollution in Missouri can be controlled through a program of education at this time. The Board is cooperating with the University of Missouri Extension Service and the Federal and State Departments of Agriculture to educate the farming public for the control of agricultural pollution. In May, 1968, the University of Missouri Extension Service completed a revised agricultural inventory for the Board on the stream basins of Missouri. This study, to be updated every three years, includes land use data, fertilizer and pesticide usage data, as well as animal and poultry production data for each basin. The Missouri Water Pollution Board does not plan to request legislation pertaining to the registration of feeders and, and/or confiners at this time. (Schmitt- Iowa State)

### 0555-A5, A8, E2, F2

**STATUS REPORT - KANSAS FEEDLOT POLLUTION CONTROL PROGRAM - EXTEMPORANEOUS REMARKS,**
Kansas State Dept. of Health, Topeka. Environmental Health Services.
M. W. Gray.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 28, February, 1969.

Descriptors: *Farm wastes, *Regulation, *Kansas, Administrative agencies, Fertilization, Cattle, *Feed lots, Waste disposal.

As a result of research undertaken approximately five years ago at Kansas State University and the University of Kansas, it was concluded that the activated sludge type of treatment of wastes from animal feedlot operations is not feasible from an economic standpoint. Retention ponds and the use of retained wastes for agricultural purposes was the key to our solution in Kansas. Although final authority for pollution control rests with the Department of Health, our problems are approached with the livestock sanitary commissioner's office, the agricultural extension service, the county agent, the consulting engineer, and the feeder. We are not seriously concerned from the standpoint of ground water pollution by way of the feedlot surface or from retention facilities. We are more concerned with the solid waste material, the manures that are cleaned from the feedlot surface and reapplied to agricultural land. The amount of nutrients that can be applied per acre is directly proportional to that which will be removed with the crop grown. We strive for cooperation and understanding from the animal feeding community, as this is essential to our program. (Schmitt- Iowa State)

### 0556-A2, A4, F2

**STATUS REPORT - NEBRASKA FEEDLOT POLLUTION CONTROL PROGRAM,**
Nebraska Water Pollution Control Council, Lincoln.
T. A. Filipi.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 29, February, 1969.

Descriptors: *Farm wastes, *Regulation, *Nebraska, Fertilization, Administrative agencies, Runoff, Cattle, *Feed lots.

Water Quality Standards have been adopted and are well-known to all persons in the state of Nebraska. Municipalities and industries have taken care of their responsibilities and other polluters must follow in the program. The problem of pollution from the industry of agriculture, specifically feedlots, was brought to the attention of the Nebraska Water Pollution Control Council by persons living downstream from the feedlots. They brought in evidence such as samples of water and photographs which clearly convinced the Council that serious pollution does occur and corrective steps must be taken. A Feedlot Operators Committee was formed and assigned to prepare rules and regulations relating to the registration of feedlots. A voluntary survey regarding the size and location of feedlots received better than 80% compliance. The next assignment of the committee is development of solutions within the economic possibility of the industry. Research is carried on by the University of Nebraska Extension Division working with the United States Dept. of Agriculture. The greatest problem that confronts Nebraska Water Pollution Control Council is that of answering questions of persons intending to set up feedlot operations, since we have no guidelines for Nebraska conditions. (Schmitt-Iowa State)

### 0557-A4, F2

**STATUS OF NORTH DAKOTA'S PROGRAM TO CONTROL POLLUTION FROM ANIMAL FEEDLOTS,**
North Dakota State Dept. of Health, Bismarck. Div. of Water Supply and Pollution Control.
N. L. Peterson.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 30, February, 1969.

Descriptors: *Farm wastes, *Regulations, *Administrative agencies, *North Dakota, Runoff, Cattle, *Feed lots.

Shortly after the state's new Water Pollution Control Board took office on July 1, 1967, they requested the State Department of Health to present to them as much information as possible on pollution from agricultural areas and, if possible, draft a proposed preliminary set of rules and regulations. The first draft was presented in October, 1967 and used Kansas proposed regulations as a guideline. An Advisory Committee on Feedlot Wastes was then established. It was composed of Health Department personnel, representatives of the Board, and representatives of the various cattle raising and feedlot operators associations. This Committee was to review and comment on proposed regulations, discuss them with their constituents, obtain comments, and recommend changes. The Advisory Committee failed to obtain many comments on the third draft of the proposed rules and regulations and decided to withhold any further action until a report on the Animal Waste Management Conference in Kansas City on February 20, 1969 could be obtained. Due to the number of variable factors involved in feedlot operation, the actual extent of pollution is difficult to establish. Thus, there is a need for much additional research into the problem of feedlot pollution. Ultimately, rules and regulations will probably be adopted. (Schmitt-Iowa State)

### 0558-A2, A4, F2

**COLORADO'S STATEMENT, STATUS, PLANS, AND NEEDS FOR A COMPREHENSIVE FEEDLOT POLLUTION CONTROL PROGRAM,**
Colorado State Dept. of Public Health, Denver. Pollution Control Div.
F. J. Rozich.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 30-31, February 1969.

Descriptors: *Farm wastes, *Regulations, *Colorado, Cattle, Legislation, Administrative agencies, Runoff, *Feed lots.

The extent of the problem of pollution attributable to feedlot wastes is being determined not only by the inventory being conducted, but also through stream studies. After public hearings and much discussion pro and con, the Colorado Water Pollution Control Commission adopted 'Rules for the Control of Water Pollution from Livestock Confinement Facilities' on April 10, 1968. Where it is determined, through field inventory and subsequent inspections, that a pollution problem does or can exist, the feeder will be asked to comply with the adopted rules. A Cease and Desist Order will be issued and an injunction sought if the feedlot operator fails to comply within a reasonable time. All types of animals corralled or tethered, including recreational horses, are included in the rules. The pace of advancement of a pollution control program is governed largely by the amount of monies and personnel available for such a project. (Schmitt-Iowa State)

### 0559-A2, A4, F2

**FEEDLOT POLLUTION CONTROL IN IOWA,**
Iowa State Dept. of Health, Des Moines. Environmental Engineering Service.
R. J. Schliekelman.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 31-32, February, 1969.

Descriptors: *Farm wastes, *Regulation, *Iowa, Cattle, Legislation, Administrative agencies, Runoff, *Feed lots, Water pollution control.

A study committee comprised of three Iowa Water Pollution Control Commission members, two agricultural engineers and the extension veterinarian from Iowa State University was formed in November, 1966 to study the feedlot waste problem and make recommendations for corrective measures. During 1967 a permanent Agricultural Advisory Committee was appointed by the WATER Pollution Control Commission to formulate tentative criteria for a permit system and tentative standards for design of feedlot runoff control systems. Four public hearings were held in April, 1968 as a part of the procedure for establishing regulations. The 'Proposed Cattle Feedlot Waste Water Disposal Regulations' defined a feedlot and described conditions under which a permit for waste disposal is required. Accompanying tentative 'Requirements for Water Pollution Control Facilities' described satisfactory facilities for handling the feedlot runoff waste. The rules and regulations were adopted by the Commission in 1968 and referred to the Legislative Departmental Rules Review Committee for final approval. Objections were voiced and the rules were disapproved. The Committee did recommend and volunteered assistance in sponsoring legislation to permit a registration procedure. Demonstration grants have been requested from the FWPCA to build model facilities, which it is felt, would do more to prevent pollution from feedlots than any other item not already undertaken. (Schmitt-Iowa State)

### 0560-A2, A3, A4, D3, E2, F2

**ANIMAL WASTE MANAGEMENT QUESTIONS AND ANSWERS,**
Federal Water Pollution Control Administration, Kansas City, Mo. Missouri Basin Region.
A. V. Resnik.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 33-34, February, 1969.

Descriptors: *Farm wastes, *Runoff, *Confinement pens, Regulation, Water pollution control.

In the initial phase of confinement livestock feeding, feedlots were, by design, situated where the rains would scour the waste materials from the lots, preferably into nearby draws and streams. We know now that the highly concentrated organic waste cannot and must not be discharged without treatment into streams. The exact contribution and the total effect of animal wastes on the water quality of the Missouri River Basin is not known. Prevention and control cannot wait while all the data are collected and assembled. Feedlot runoff pollution could be greatly reduced with a minimum expenditure by utilizing known information. Regulations are necessary to insure the feedlot operator that the measure he is taking will guarantee a reasonable tenure of operation. Uniformity which concurrently allows for flexibility must be built into the regulations, since there is no one model or control device that will substantially alleviate animal waste pollution. Possible control methods include, (1) zoning of entire watersheds for livestock production, (2) government built 'first generation' plants of new concept and design, (3) development of supplemental range feeding programs, and (4) composting a mixture of manure and municipal garbage for use on a 'greenbelt' separating the city from the animals. (Iowa State)

### 0561-A2, A4, F2

**INVENTORY AND ASSESSMENT OF THE PROBLEM OF POLLUTION FROM FEEDLOT WASTES,**
North Dakota State Dept. of Health, Bismarck. Div. of Water Supply and Pollution Control.
N. L. Peterson.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 34-35, February, 1969.

Descriptors: *Farm wastes, *Runoff, Confinement pens, Cattle, Pollution abatement, Regulations, *Feed lots.

Feedlot wastes differ from municipal and industrial wastes in that they are not confined nor do they have predictable flows. The wastes from feedlots generally reach the stream only during periods of runoff. The first step toward assessment of the pollution problem might be to determine areas of the state where most feedlots are concentrated and what major or minor river basins have the highest potential of being polluted at times of feedlot runoff. The next step might be to develop an inventory of feedlots including data on location, topography, number of cattle, and other characteristics of the lot operation and management. Methods of obtaining inventory information might be through permits, County Extension Offices, farm associations, and perhaps through individual personal contact. A state water pollution control agency, adding pertinent weather data to this information, should be in a position to access the pollution potential, both individually and for each river basin. Certainly much can be accomplished if the state water pollution control agency makes a sincere offer of assistance and advice to individual feedlot operators. Rules should be drawn up for the purpose of assisting the state agency and the feedlot operator to solve a mutual problem. (Schmitt-Iowa State)

### 0562-A2, A6, A13, B1, F2

**ASSESSING THE PROBLEM OF FEEDLOT POLLUTION,**
Missouri Univ., Columbia. Dept. of Agricultural Economics.
C. G. McNabb.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 35-36, February, 1969.

Descriptors: *Farm wastes, *Runoff, Confinement pens, Cattle, Pollution abatement, Legislation, *Feed lots.

Cattle feedlots have been receiving an increasing amount of attention from pollution conscious people because of their growing number and size, they can be seen and smelled, and our affluent society is becoming more concerned with esthetic values. Action is demanded and we must progress using the best information available while trying to secure additional data. A partial list of useful data might include (1) quantity and capacity, (2) number of impoundments to catch runoff, (3) how the solids and liquids are handled, (4) the slope and length of slope, and (5) the soil type. Eventually the data should help us determine what effect feedlots have on the water quality of a basin. One method of developing an inventory is to legislate a permit requirement. A more desirable method is to voluntarily work with livestock organizations to gather information and set guidelines for pollution abatement. However, at the present time much uncertainty exists on the type of pollution abatement facilities that are effective and feasible. An information-education program is needed to create an awareness of the pollution problem by the livestock people. Awareness should precipitate more cooperation with agencies involved as well as initiate voluntary abatement programs. (Schmitt-Iowa State)

### 0563-A2, F2, F3

**A RECOMMENDED PROCEDURE FOR DEVELOPING A MODEL FEEDLOT REGULATION,**
South Dakota School of Mines and Technology, Rapid City.
F. L. Matthew.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 37-38, February, 1969.

Descriptors: *Farm wastes, *Runoff, *Regulation, Pollution abatement, Cattle, Legislation, Confinement pens, *Feed lots, *Model studies.

In the development of a feedlot regulation, other alternatives should first be considered and the need for a regulation firmly established. Next it is necessary to establish general and specific objectives for the proposed regulation. After establishing objectives, restraints should be considered. Budget and staff limitations will normally be the most important restraints on the implementation program. The last step is to establish evaluation criteria which should include: (1) preventive or corrective nature, (2) clear information about the feedlot operators obligations, (3) enforceability within staff budget restraints, (4) provisions for appeal, (5) avoidance of discrimination, (6) control of both new and existing facilities, (7) control of construction and operation, (8) provisions covering ultimate disposal of wastes, (9) provisions for periodic updating, (10) compatibility with existing Federal, state and local laws, (11) definitions of pollution and pollution parameters, and (12) establishment of effluent quality standards and specification of sampling procedures. When these steps have been taken and necessary public information programs are underway, the development of the feedlot regulation and implementation program plans can proceed. (Schmitt-Iowa State)

### 0564-A4, A5, A8, B2, B3, C1, C2, C3, D3, E2, E3, E4

**RESEARCH NEEDS IN CATTLE FEEDLOT WASTE CONTROL,**
Kansas State Univ., Manhattan. Dept. of Civil Engineering.
L. A. Schmid.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 38-39, February, 1969.

Descriptors: *Farm wastes, *Research and development, By-products, Pollution abatement, *Feed lots.

Although research priorities cannot be neatly separated since most of the categories are interrelated, certain areas should receive increased research emphasis. Characterization of wastes should be included in studies wherever possible. The sanitary engineer's fundamental knowledge of biological waste treatment and other processes is sufficient that he can design a process, biological or otherwise, based on a knowledge of the waste characteristics. Biological treatment in a liquid system of the manure scraped from a feedlot should not warrant a high degree of priority, since most of the biodegradable solids have already decomposed depending on the age of the manure and the conditions involved. Return to the land appears to be the most favored method of disposal. We know very little of the effect of the heavy loading anticipated from large feedlot operation, but somewhere there must be a balance between rate of waste disposal, land destruction, and crop production while satisfying the primary goal of pollution control of both surface and ground water. The next priority deals with either management practice or processes that reduce the solid or liquid waste that comes from the lot. Reuse of wastes as feed material and other by-product recovery schemes may require attention in the future. (Schmitt-Iowa State)

### 0565-A4, A5, B1, B5, F1

**RESEARCH AND DEVELOPMENT VIEWS OF ANIMAL WASTE MANAGEMENT,**
Federal Water Pollution Control Administration, Washington, D.C. Div. of Applied Science and Technology.
H. Bernard.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 40, February, 1969.

Descriptors: *Farm wastes, *Waste treatment, Cattle, Pollution abatement, Administrative agencies, Research and development, Water pollution control.

The problem of the waste from animal feeding must be considered not only as a pollution abatement problem, but rather as an animal feeding or an animal management problem in which waste management is considered as an integral part of the overall problem of making a profit from your investment. The prime consideration is to maximize profit taking into account the additional cost of waste management. This could even mean changing the feed to decrease the amount of wastes produced or the quality to make it easier to handle the waste products. The Office of Research and Development of the FWPCA is anxious to demonstrate new or improved techniques for handling and treating animal wastes that reduce the pollutional load to receiving streams or ground water. Participation with industry can include up to 70% of the total cost. The nation as a whole desires pollution abatement to become an integral part of our economy and expects a definite improvement in our environment. (Iowa State)

### 0566-F2

**DEVELOPING AN ANIMAL WASTE MANAGEMENT ACTION PROGRAM,**
Missouri Univ., Columbia. Agricultural Extension Div.
S. H. Bodenhamer.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 40, February, 1969.

Descriptors: *Farm wastes, *Regulation, *Legislation, Pollution abatement, Water pollution control.

Many dynamic forces will affect the implementation of a desired animal waste management program. Before attempting to initiate change, any social system should (1) define the situation to be changed, (2) describe the desired situation, (3) list what needs to be done to accomplish the desired, and (4) describe the resources available and those that are needed. A listing of the different audiences or interest groups can be helpful in preparing a message for them. Each audience will need to see how the change will help them satisfy their own needs for goods, services, and attitudes. Decide on what method is to be used to reach each audience, as change is best brought about through good communications and cooperation. Methods may be influenced by the size of the audience and their state of adoption. Those to affect or be affected by animal waste management programs must be involved in deciding what should be the program. Cooperation is positively correlated with the degree of involvement the parties to be affected are involved in shaping the proposed action. (Schmitt-Iowa State)

### 0567-A1, A12, C3

**BACTERIAL AND FUNGAL FLORA OF SEAGULL DROPPINGS IN JERSEY,**
Jersey General Hospital, St. Helier (England).
J. Cragg, and Y. M. Clayton.
Journal of Clinical Pathology, Vol 24, No 4, p 317-319, 1971. 12 ref.

Descriptors: *Animal wastes (Wildlife), *Bacteria, *Fungi, Waste identification, E. coli, Streptococcus, Yeasts, Salmonella, Shigella, Seashores, Sampling, Laboratory tests, Gulls.
Identifiers: *Seagull, Mycology, Jersey.

In Jersey 166 fresh and 122 dried seagull droppings were obtained and studied locally and in London for the presence of bacteria and fungi of potentially pathogenic nature. There were no salmonella or shigella bacteria isolated from the two groups but there was a high proportion of Candida albicans obtained from the fresh material (21.7%) and only 1.6% from the dry faeces. Cryptococcus neoformans and Histoplasma capsulatum were not found in either the dry or fresh droppings. The normal bacterial and fungal flora of the seagull was established and it is considered that the C. albicans in fresh gull droppings would not materially increase albicans infections in man. (Bundy-Iowa State)

### 0568-D1, D2, E4

**DEAD BIRD DISPOSAL BY RENDERING,**
California Univ., Riverside.
W. C. Fairbank, and E. L. Bramhall.
Poultry Digest, Vol 30, No 358, p 600-601, December 1971.

Descriptors: *Farm waste, *Chickens, *Waste disposal, *By-products, Artificial use.
Identifiers: Rendering.

The reduction of dead poultry, and poultry viscera, feathers, cockerels, and unmarketable eggs to salable by-products is probably the most nearly perfect disposal method for these wastes. Rendering is a recycling process. Meat, bone, and feather meal are used in formulation of livestock and pet foods. The rendered 'yellow grease' is used mainly by feed, soap, and chemical industries. Usually no payment is made to the poultry supplier, but receptacles with tight-fitting lids are supplied. Whole carcasses are cooked and fed uniformly to a tapered screw oil expeller or press. Dead whole poultry yield 50% recovery, 25% of which is grease and 75% meal. The value of meal (about 58% crude protein and 4% crude fats) is approximately four cents per pound. The value of feed grade yellow grease is about seven cents per pound. Restaurant grease, butcher shop trimmings, and small animals can be blended to provide sufficient volumes for continuous use of the rendering plant cookers. A layer population of several million hens is necessary to supply adequate mortalities if there is no other source of compatible waste. (Schmitt-Iowa State)

### 0569-A11, E2

**ENZYMATIC EVALUATION OF PROCESSES FOR IMPROVING AGRICULTURAL WASTES FOR RUMINANT FEEDS,**

Agricultural Research Service, Albany, Calif.
Jack Guggolz, R. M. Saunders, G. O. Kohler, and T. J. Klopfenstein.
Journal of Animal Science, Vol 33, No 1, p 167-170, July 1971. 4 fig, 1 tab, 14 ref.

Descriptors: *Farm waste, *Enzymes, *Biochemistry, *Digestion, *Biodegradation, *Ruminants, Cattle, Sheep, Degradation, Refuse, Cellulose, TDN, Alfalfa, Forages, Lignin.
Identifiers: *Onozuka SS, *Agricultural residues, Roughage, Hemicellulose, Reed canary grass, Smooth bromegrass, Tall Fescue.

Agricultural residue high in cellulose and hemicellulose are a potentially valuable source of energy to ruminant animals, but low digestibility of the carbohydrates make some type of chemical or physical modification necessary. A procedure has been developed enabling one to correlate 'in vivo' digestion of residues with 'in vitro' dry matter disappearance. The procedure involves digestion of the crop residue or forage with a crude cellulose enzyme followed by protease digestion. 'Onozuka' SS was found to be the most active cellulose and was added at a rate of 750 milligrams per gram of residue, and incubated at 40C for 72 hours. At the end of incubation a series of procedures was followed to separate and weigh the remaining residue. Onne hundred minus the percent residue was called 'total solubles after enzymes' (TSAE). The correlation coefficient between enzymatic and 'in vivo' results for alfalfa, reed canary grass, smooth bromegrass, and tall fescue were 0.997, 0.876, 0.998, and 0.999 respectively. The procedure appears to predict dry matter digestibility with sufficient precision to be of use to laboratories with no access to donor ruminant animals. (Schmitt-Iowa State)

### 0570-A9, A10, C3, D2

**MANURE MITES AND THEIR ROLE IN FLY CONTROL,**

Kentucky Univ., Lexington. Dept. of Entomology.
J. G. Rodriguez, Pritam, Singh, and Bob Taylor.
Journal of Medical Entomology, Vol 7, No 3, p 335-341, 1970. 2 fig, 4 tab, 30 ref. Public Health Service No CC 00207.

Descriptors: *Farm wastes, *Insect control, *Mites, Cattle, Poultry, Larvae, Oviposition, Insecticides, Diazinon, Insect eggs, *Waste treatment, Toxicity.
Identifiers: *Flies.

Glyptholaspis confusa (Foa) and Macrocheles muscaedomesticae (Scopoli) generally attain their highest populations in stock piles of cattle manure in the fall and early spring. Their food during the fly-free season consists mainly of nematodes. In poultry houses populations of M. muscaedomesticae start building up in manure in the summer. Fuscuropoda vegetans (DeGeer) attains high populations in early summer and continues to build up as the season progresses until late fall. Acarine control of the house fly in a poultry house under semi-field conditions ranged from 86 to 99%, depending in the mites involved. Fourteen chemicals were tested in the laboratory for toxicity to newly-hatched maggots of the house fly and the adult, M. muscaedomesticae. Diazinon, ronnel, Bayer 38156, malathion and dimethoate were relatively toxic to the house fly maggot and relatively non-toxic to the mite. Sugar-based baits were used against the adult flies in the integrated control program with promising results. (Parker-Iowa State)

### 0571-A3, A8, B2, C2, D3, E2

**EFFECT OF METHOD OF MANURE HANDLING ON CROP YIELDS, NUTRIENT RECOVERY AND RUNOFF LOSSES,**

Wisconsin Univ., Madison. Dept. of Agricultural Engineering; and Wisconsin Univ., Madison. Dept. of Soils.
R. R. Hensler, R. J. Olsen, S. A. Witzel, O. J. Attoe, and W. H. Paulson.
Transactions of the American Society of Agricultural Engineers, Vol 13, No 6, p 726-731, November-December 1970. 10 tab, 26 ref. OWRR-14-01-0001-858.

Descriptors: *Farm wastes, *Crop production, *Application methods, Runoff, Nutrients, Greenhouses, Waste disposal, Chemical analysis, Fertility, Soil chemical properties.
Identifiers: *Nutrient recovery, Anaerobic liquid manure, Aerobic liquid manure.

A study was made of the effect of type of manure, method of handling, amount of bedding, drying treatment, and rate of application on the fertilizing value of cattle manure for corn and hay and on runoff losses. Dairy and beef cattle manure was applied as fresh, fermented, aerobic liquid and anaerobic liquid, both in greenhouse conditions and in actual field tests. Tests were run to determine nutrient loss before application and nutrient recovery by plants and runoff losses after application. Results showed increased corn dry matter in all cases of manure application with poorer results shown by the aerobic liquid than the other three. Allowing manure to dry for one week before incorporation usually gave lower yields and lower recovery values for N, P, and K. Total dry-matter yields of corn were not greatly affected by increasing amounts of bedding up to 8 percent, but at the 16 percent rate, yields were usually much lower. (Parker-Iowa State)

### 0572-A9, A12, B3, C2, C3, D1, D2, E3

**AN ASSESSMENT OF SOME PUBLIC HEALTH PROBLEMS RESULTING FROM FEEDING POULTRY LITTER TO ANIMALS. MICROBIOLOGICAL AND CHEMICAL PARAMETERS,**

Food and Drug Administration, Cincinnati, Ohio. Div. of Microbiology.
James W. Messer, Joseph Lovett, Gopala K. Murthy, Albert J. Wehby, and Mary L. Schafer.
Poultry Science, Vol 50, No 3, p 874-881, May 1971. 3 tab, 14 ref.

Descriptors: *Farm wastes, *Poultry, *Disposal, *Feeds, *Public health, Cattle, Hogs, Sheep, Pesticide residues, Microbiology, Health, Diseases, Salmonellae, Sewage, Bacteria, Arsenic compounds.
Identifiers: Food and Drug Administration, Medicinals, Ultraviolet-light-activated substances.

Feeding studies on the utilization of poultry litter as a feed additive for ruminants have demonstrated satisfactory animal nutrition, thus, opening many questions of public health significance. This study examined the heat resistance of salmonellae and Arizona pathogens; whether heat treatment of poultry litter would provide an effective barrier against disease transmission; and determined the levels of some medicinals, pesticides, and ultraviolet light activated compounds in poultry litter. Results showed that a heat process for the elimination of salmonellae and Arizona sp. may be feasible, since they are not highly resistant to heat. E. Coli being less resistant to moint heat than salmonellae, were eliminoted as an indicator of the efficiency of the heating process. With the exception of arsenic, the concentration of pesticides and medicinals present in the litters assayed in this study were low. On the basis of the highest observed values in litter, beef cattle and dairy cattle fed 30% of their diet as litter would receive approximately 46.0 mg of arsenic, 19.0 milligrams of uric acid, 16.0 milligrams of nitrofurazone, 15.0 milligrams of furazolidone, and 1.4 milligrams of ultraviolet-activatable substances per day. The possibility of higher levels and the unknown effect of continuous exposure to low levels suggests the present ban on the interstate shipment of poultry litter for animal feed is warranted. (Schmitt-Iowa State)

### 0573-A2, B2, B4, C1, C2, D1

**METHODS OF REMOVING SETTLEABLE SOLIDS FROM OUTDOOR BEEF CATTLE FEEDLOT RUNOFF,**

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
C. B. Gilbertson, T. M. McCalla, J. R. Ellis, and W. R. Woods.
Transactions of American Society of Agricultural Engineering, Vol. 14, No. 5, September-October 1971. p 899-905, 19 fig, 2 tab, 11 ref.

Descriptors: *Farm wastes, Runoff, Cattle, *Settling basins, Waste disposal, *Feed lots, *Waste water treatment.
Identifiers: *Liquid storage, Continuous flow, Batch system, *Feedlot runoff.

Two experimental systems were installed to study removal of settleable solids from runoff. One method, termed the 'batch' system, consisted of a primary settling basin and a secondary basin. All runoff from a given storm event was trapped within the primary settling basin and detained to allow the heavier solids to settle to the bottom of the basin. The supernate was pumped from the primary basin into the secondary basin for longer detention times. The other concept was termed 'continuous flow.' Runoff resulting from a storm moved continuously through a series of porous dams. The porous dams reduced the velocity of flow sufficiently to allow the heavier particles to remain in the settling channel while the liquids flowed by gravity to a liquid storage pond. Results of the 1-1/2 year study are: (1) The concentration of chemicals and solids in runoff was highly variable for rainfall-runoff events; (2) Rainfall runoff transported about 1.6 tons of solids per acre-inch, while winter runoff transported about 10 tons per acre-inch; (3) The batch system removed settleable solids efficiently; however, the system maintenance had considerable disadvantages; (4) The continuous flow concept may be readily adapted to many of the feedlots experiencing runoff problems; (5) Settling of solids presents more of a problem during cold weather. (Bundy-Iowa State)

### 0574-B2,C2,C3,D3,E1,F1

**OXIDATION DITCH IN A CONFINEMENT BEEF BUILDING,**

Illinois Univ., Urbana. Dept. of Animal Science; and Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. D. Jones, D. L. Day, and U. S. Garrigus.
Transaction of the ASAE, Vol. 14, No. 5, Sept.-Oct 1971. p 825-827, 6 fig, 2 tab, 1 ref.

Descriptors: *Farm wastes, *Confinement pens, *Oxidation lagoons, Aerobic bacteria, Costs, Cat-

tle, *Waste water treatment, Biochemical oxygen demand, Chemical oxygen demand.
Identifiers: *Beef cattle wastes.

Disposing of beef cattle wastes with an in-the-building oxidation ditch is being studied by the Departments of Animal Science and Agricultural Engineering in an experimental beef-confinement facility at the University of Illinois Beef Farm. Waste from cattle consuming rations of high-roughage and high-concentrate was studied during a four month test period from March through June, 1969. Field trials indicated that the in-the-building oxidation ditch is a satisfactory method of treating beef cattle waste. Loading rates of 55 cm ft of oxidation ditch per 800 pound fattening calf and 80 cu ft per cow and calf were used. The 5-day mixed-liquor biochemical oxygen demand values were less than 1,000 mg per liter and the supernatant BOD5s were usually less than 200 mg per liter. The chemical oxygen demand values were extremely high (up to 55,000 mg per liter) due to the high cellulose ration fed to the first group of animals. There was some evidence that biological activity was influenced by cold climates. Assuming a daily BOD5 production of 1.3 pound per 1000 pound beef feeder and a power cost of 2 cents per KWH, the aeration rotor operating cost would be about 2.5 cents per 1,000 pound animal per day. This would be about 1 cent per pound of gain. (Schmitt-Iowa State)

### 0575-A6, A13, B2, B4, D3 E2

**POULTRY WASTE HANDLING SYSTEMS,**
Cornell Univ., Ithaca, N. Y. Dept. of Poultry Science.
C. E. Ostrander.
Poultry Digest, November 1971, p 529-532.

Descriptors: *Farm waste, *Odors, Drying, Aerobic, Anaerobic, Poultry, Oxidation lagoons, Design, Effluents, Waste water disposal, Fertilizer, Hydraulic structures, Waste management.
Identifiers: Storage capacity, Plow-down application, Laying cages, Deep pits.

The problems of waste management have become increasingly important primarily because of increasing in flock size, concentration of birds and population migration to the country. There are several waste handling systems, none of which is adaptable to all situations. Some of the more popular types of waste handling systems are: (1) deep pits which are capable of handling at least 6 to 9 months storage, (2) hydraulic systems with aerated lagoon, and (3) oxidation ditches. Spreading of slurry taken from the storage pits also creates problems, if not handled properly. If liquid spreaders are used, the spreaders should be enclosed to reduce odors on public roads and on other property. In the spreading of manure by the use of plow-down application method, the material is poured into the furrow followed up by plowing. The soil being a very good filter, reduces the odors. Regardless of the practice followed in handling waste products, care should be taken to avoid a poor image in the community. (Bundy-Iowa State)

### 0576-A6, A7, C2

**CHEMICAL OXYGEN DEMAND OF GASEOUS AIR CONTAMINANTS,**
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
J. D. Frus, T. E. Hazen, and J. R. Miner.
Transactions of the ASAE, Vol. 14, No. 5, 1971. p 837-840, 5 fig, 6 tab, 8 ref.

Descriptors: *Farm wastes, *Odors, *Chemical oxygen demand, Air pollution, Ammonia, Confinement pens, Analytical techniques, *Oxygen demand.
Identifiers: *Organic gases.

In an attempt to quantify the atmosphere of a confinement swine building according to odors, the chemical oxygen demand analysis was modified and used to analyze the atmosphere within the building. Air was pulled through a 0.8 micron filter to 3 culture tubes containing equal parts of 0.025 N K2Cr2oO7 and concentrated H2SO4. The volume of air was measured with a wet-test meter. It was concluded that (1) the COD technique can be used as a quantitative measure of the organic gases present, (2) the air COD values can be correlated with noticeable differences in odor level as detected by the human nose, (3) the air COD technique detected different gases when the pH of the manure was above 7.0 than when it was below 7.0, (4) the air COD value rises sharply when the ventilation is turned off and drops sharply when it is turned on again, (5) the air COD values are lowest when the pH of the manure in the pits is in the 6.8 to 7.2 range. The effect of absorbent temperature on the air COD values and the sensitivity of the COD technique to individual organic gases need further exploration. (Schmitt-Iowa State)

### 0577-A6, A7, C2

**BLOCK DRYING OF CHICKEN MANURE,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
Compost Science, Vol 11, No 3, 1 tab, 1970. p 28-29, 3 fig, 3 ref.

Descriptors: *Farm wastes, *Drying, *Poultry, Moisture content, Odor, Nitrogen, *Waste treatment.
Identifiers: Block drying.

Blocks of chicken manure were air dried to form a storable product with minimum odor. Reductions in weight, volume, nitrogen, and viable organisms were obtained during the drying period and following storage period. Due to moisture loss during drying, the blocks experience a weight reduction to 29 percent of the initial weight. Shrinkage can result in a volume reduction of approximately 50 percent. The reduction in viable organisms over a 3-3/4 period is substantial but a large number of organisms still exist. Nitrogen is lost during the drying and storage period. (Bundy-Iowa State)

### 0578-A6, A7, A8, A11, B2, B4, C2, C3, D1, D3, E2

**COLLECTION AND DISPOSAL OF FARM WASTES,**
Ministry of Agriculture (Northern Ireland).
J. S. V. McAllister.
Water Pollution Control, Vol 69, No 4, p 425-429, 1970. 6 tab, 5 ref.

Descriptors: *Farm wastes, *Slurries, Sewage, Aeration, Incineration, Biochemical oxygen demand, Farm lagoons, Water pollution, Nitrogen, Ammonia, Methane, Hydrogen sulphide, Phosphorous, Waste water disposal, Waste water treatment.

Identifiers: *Pig slurries, *Poultry droppings, *Cattle excreta, Silage.

Improved farming techniques, suburban development, and a wider realization of the necessity to control pollution of the atmosphere and water supplies have increased the problem of farm waste collection and disposal. Generally, in Europe farm wastes are collected in the form of a slurry but disposing of this slurry is a problem. The use of this slurry as a manure has certain drawbacks and alternative methods of disposal such as drying, incineration, aeration treatment, or synthesis of feeding stuffs are explored. (Ellis-Texas)

### 0579-A6, B2, D3, E1

**OXIDATION DITCHES CAN ELIMINATE ODORS, MANURE HANDLING AND POLLUTION,**
John Russell.
Farm Journal, Vol 94, No 8, p H-10, H-15, August 1970.

Descriptors: *Farm wastes, *Hogs, *Waste treatment, Activated sludge, Odors, Aeration.
Identifiers: *Oxidation ditch, *Hog confinement, Odor control, Smart Pork Farm, Lawrence (Kans).

The use of oxidation ditches is described in a swine confinement system for 5000 head annually near Lawrence, Kansas. Thousand head finishing buildings have two oxidation ditches each with 4 rotors or wheels in each ditch. Organic matter removal is in excess of 90 percent. Operating costs approximate one dollar per head. Effluent is discharged to holding ponds for evaporation thereby eliminating all manure hauling. (Miner-Iowa State)

### 0580-A9, B2, E2

**ENGINEERING PRINCIPLES IN HANDLING LIQUID MATERIALS,**
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
C. M. Hansen.
Agricultural Engineering, Vol 39, p 546-551, Sept 1958. 13 fig, 1 tab, 8 ref.

Descriptors: *Farm wastes, *Fertilizers, *Pumps, Hydraulic equipment, Liquid wastes, Liquids, Pesticides, Spraying, Herbicides, Hogs, Nematocides, Measurement, Centrifugal pump, Farm equipment, Cattle.
Identifiers: *Dairy cattle, Anhydrous ammonia, Rotameter, Aqua ammonia, Liquid feeds, Helical rotor pump.

Various methods of handling liquid fertilizer, liquid feeds, pesticides, nematocides, and liquid manure are discussed with special emphasis given to the type of pumps recommended for each. Anhydrous ammonia is usually transferred by a bleeding system or a vapor-return system. It is commonly applied to the soil by employment of the pressure differential system. Aqua ammonia is transferred by centrifugal pumps as are many herbicides. Pesticides are recently being applied with air-blast pumps which use both air and water as a carrier of the pesticide. A most successful hydraulic pump for handling soil fumigants has the nylon roller impeller. This pump needs to be flushed with Kerosene or Stoddard solvent. The helical rotor pump with a rubber or synthetic rubber stator is a new pump for handling liquid manure in the semisolid form. By pumping semisolids, a Missouri farmer is able to weekly flush the wastes from a 350-hog installation with only 2,500 gallons of water. Dairy cow wastes are also a semisolid, as 56% of the 12-15 gallons per day water consumption is excreted in the feces while only 13% is excreted in the urine. (Schmitt-Iowa State)

### 0581-A8, B3, E2

**BROILER LITTER ON WELSH COAL TIPS,**
Colin White.
Agriculture. Vol 77, No 2, February 1970, p 49-51.

Descriptors: *Poultry, Farm wastes, *Coal mine wastes, *Land reclamation, Perennial ryegrass, Vegetation establishment, Germination.
Identifiers: *Broiler litter, Field trials, South Wales.

In South Wales large areas of land occur as gigantic coal spoil tips. Interested local authorities are increasingly concerned that disused tips should be landscaped. Presently, however, up to five years may elapse before this land is considered suitable for return to agricultural use. The National poultry laying flock produces 2,000,000 tons of fresh manure per annum. This poultry manure has values that may fit it well for use on derelick land. Tests and trials were arranged to see if poultry manure could ameliorate the harsh conditions presented in trying to establish grass on coal tips. Hen battery slurry was first considered and used in the first germination test. Italian ryegrass seed was mixed with the slurry and applied to tip material. Germination was only about 50%. Next the grass seed was placed on the tip material and then covered by broiler litter. No loss in germination was found with this second method. Field tests were then made using this technique. The results were satisfactory. Further trials and observations are being conducted on tips and restored opencast sites. (Parker-Iowa State)

### 0582-A7, B1, F1

**CRITERIA NEEDED TO DESIGN ANIMAL QUARTERS FOR COMFORT AND PRODUCTIVITY,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
T. E. Hazen.
Journal of Animal Science, Vol 32, No 3, p 584-589, 1971. 20 ref.

Descriptors: *Design criteria, Farm wastes, Research needs, Air pollution effects, Farm management, Confinement pens, Investment economics, Temperature control.
Identifiers: Animal quarters, Air purity.

Several reasons account for the shortages in livestock housing design. The most frequent reason is either the added construction or operating cost necessary to obtain something better. Very little is known about the chemical and biological environment systems and the quantitative effects they may have on animal comfort and productivity. In this respect, manure management is now under intensive study because fecal and urinary wastes appear to contribute most to the formation of undesirable conditions. Reasonably adequate data are now available on the treatment and disposal of wastes, but acceptable systems are lacking for separating the manure safely and efficiently from the animal and surroundings. (Bundy-Iowa State)

### 0583-A6, A7, A9, A13, B1

**AIR POLLUTION FROM AGRICULTURE,**
Nebraska Univ., Lincoln. Coll. of Agriculture.
L. F. Elliot, and T. M. McCalla.
Proceedings, Exploring Nebraska's Pollution Problems, symposium article No 31275; Journal Series, Nebraska Agricultural Experiment Station, April 22, 1971. p 1-6, 29 ref.

Descriptors: *Farm wastes, *Air pollution, *Dusts, *Odor, Aesthetics, Erosion control, Land management, Weed control, Pesticide drift, Dust storms, Wind erosion, Pollen, Smoke.
Identifiers: *Allergens, *Fatty-acids, Aerosol drift, Ragweed pollen, Stubble mulching.

The major atmospheric pollutants from agriculture are dust, allergens, odors, pesticides, and smoke. The reduction of these pollutants through improved management practices can be demonstrated. Dust can be controlled by proper cropping systems and management. Allergens can be decreased by weed control. If the surface of animal wastes is maintained aerobically, little or no odor will exist. Problems in reducing odor production in animal confinement units are discussed along with known odor causing chemicals present in these units. However, the control of odors by chemicals are usually of short duration and the chemicals are prohibitively expensive. (Dorland-Iowa State)

### 0584-B1, F1, F2

**STATE REGULATIONS PERTAINING TO LIVESTOCK FEEDLOT DESIGN AND MANAGEMENT,**
Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.
W. F. Schwiesow.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 19-25, 1 tab.

Descriptors: *Farm wastes, Runoff, Water Quality Act, Regulation, Odor, Permits, Water pollution, *Feedlots.

Uniformity of livestock feedlot design and management regulations is desirable so feedlot operators in one state do not have an advantage over operations in another state. Information is being made available to governmental authorities and other interested people in an endeavor to assist in obtaining a degree of uniformity. Interest in the quality of environment has led to many requests for information on state regulations pertaining to livestock feedlots. A summary of the material received may be categorized as follows: (1) regulations concerning feedlot construction, (2) control through other existing regulations, such as water quality standards or public health requirements, (3) no specific regulations that are considered applicable. Definitions for feedlots vary from state to state. Some states define a feedlot as any livestock confinement area where vegetation suitable for livestock consumption does not grow. Other states specify a minimum number confined at any one time. In most states, a penalty is charged for violation of regulations. Penalties range from $10 to as high as $1,000 fine. All 50 states have water quality standards which have been wholly or partly approved by the federal government. Recently passed legislation on air quality standards will cause the development of additional regulation for feedlot construction and management.

### 0585-C2

**BOD POSES PROBLEMS FOR POULTRY GROWERS AND PROCESSORS,**
Griffith (Llewellyn B.), Falls Church, Va.
C. C. Griffith.
Water and Sewage Works, Vol 117, No 1, p IIW/9-IW/14, Jan-Feb 1970. 1 fig, 3 tab.

Descriptors: *Farm waste, Poultry, Biochemical oxidation demand, Organic matter.
Identifiers: *Poultry processing plant, Broilers, Live weight, Blood waste.

The BOD from poultry processing plants and parameters by which it can be estimated with meaningful accuracy are necessary when designing facilities. Graphs plotted ftom the data consistently produce a curve whose slope is upward as the size of the bird processed is increased. The BOD load cannot be expressed accurately in terms of production units of either head count or gross live-weight unless the average live-weight per bird processed is considered. The available data is not considered to be sufficiently comprehensive to permit precise calculation of BOD loads imposed by the larger birds of today, but it is adequate to raise a warning flag which should alert those involved to the probability that treatment plants designed according to the old criteria may be underdesigned by a factor of two where 4 lb. birds are being, or soon will be, processed. (Bundy-Iowa State)

### 0586-A3, A6, A7, A10, B2, B3, B4, C1, C2, D3, E2

**CATTLE FEEDLOTS AND ALTERNATIVES FOR WASTE MANAGEMENT,**
Environmental Protection Agency, Portland, Oreg. Water Quality Office.
C. E. Veirs.
Oregon State University, Water Resources Research Institute, Seminar, WR 014.71, July 1971, p 65-76. 9 ref.

Descriptors: *Livestock wastes, *Water quality control, *Confinement pens, Manure lagoons, Settling basins, Land management, Fertilizers, Storm run-off, Nitrates, Groundwater, Incineration, Waste water treatment, Coliforms, Cattle, Sheep, Hogs, Design criteria, Pacific Northwest.

Daily waste production of domestic animals is 10 times the waste production of the human population of the U.S. Per capita beef consumption has risen 34% from 1950 to 1960, while meat consumption overall has risen 15%. To meet the demand, the number of beef cattle in the U.S. has gone from 85 million head in 1945 to 108 million head in 1965, a 27% increase. Prior to the advent of large feedlots, wastes were returned to the land to aid in feed production, but many feed lots have concentrated so many animals that there is not enough land nearby upon which to spread the wastes. Waste treatment facilities are now becoming necessary to these operations. The most common are oxidation lagoons and ditches, although incineration and composting are simulating considerable interest. Sight selection guidelines, design criteria, and waste management suggestions are presented. The development of new techniques and the utilization of known conservation practices can and should be combined to achieve water quality control as well as soil and water conservation.
(Lowry-Texas)

### 0587-A6, A8, C2, E2

**HYDROGEN SULFIDE AND METHYL MERCAPTANS REMOVALS WITH SOIL COLUMNS,**
Washington Univ., Seattle. Dept. of Civil Engineering.
D. A. Carlson, and R. C. Gumerman.
Proceedings of the 21st Prudue Industrial Waste Conference, Extension Series 121, 1966. p 172-191, 14 fig, 3 tab, 8 ref.

Descriptors: *Degradation, *Hydrogen sulfide, Soil bacteria, Soil types, Odor, Sulfur bacteria, Pseudomonas, Anaerobic conditions, Loam, Sands, Clays, *Waste treatment.
Identifiers: *Methyl mercaptan, *Soil filters, Elution water, Sulfuric acid.

Recently, the soil siltration principle has been introduced and successfully applied to odors emanating from sewage. On this basis, a soil filtration system was chosen to experimentally remove hydrogen sulfide and methyl mercaptan from air. Soil columns 3-1/2 feet long were used over a period of six to eight weeks. On concentrations of 15 mg/l hydrogen sulfide and 775 mg/l methyl mercaptan, efficiencies approached 100%. Different types of soil were used with artificially enriched fertile loam soil being superior in degradative ability to clay, sand, and sandy loam soils. No optimum soil depth could be established, since bacterial population was still increasing at the end of the test period. It appears that a depth of 3.5 feet is near the maximum necessary. The effect of gas settling of the mercaptan gas upon entering the soil columns was negligible. A back pressure of 1.5 inches of water existed in a moist fertile loam soil at a flow rate of 0.35 cfm. (Dorland-Iowa State)

### 0588-B1, B5, C2 ,D3

**EFFECT OF TEMPERATURE ON AEROBIC DECOMPOSITION OF DAIRY CATTLE MANURE,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
J. C. Nye, A. C. Dale, and D. E. Bloodgood.
Transactions of the ASAE. Vol 14, No 3, p 545-48, May-June, 1971. 8 fig, 3 tab, 7 ref.

Descriptors: *Farm wastes, *Aerobic treatment, *Waste disposal, *Livestock wastes, Ruminants, Sewage disposal, Oxidation, Cattle.
Identifiers: Phenyl pyruvic acid.

Temperature has an effect on the aerobic biodegradation of ruminant fecal wastes, which are about 25% lignin and protein, and 25% undigested feed and bacterial cells. A manure mixture of 2 parts feces and 1 part urine was fed into five decomposition chambers at a rate of 90 grams per 6 liters per day. After 28 days, batch feeding replaced daily feeding in the chambers which ranged in temperature from 35 to 75F. On the 74th day the entire contents of the chambers were dried. When semi-continuous feeding was stopped, the solids concentration of the supernatant decreased to a minimum of 4000 mg/l in the warmest chamber. As this minimum was reached the pH dropped from 7.8 to 5.7 in seven days. This may have been caused by the formation of phenyl pyruvic acid as lignin was transformed to humos. In an aerobic system with a detention period of 74 days at temperatures above 65F, a reduction in volatile solids of 70 percent can be attained. In the same type of system at 48F, only 45% reduction of volatile solids is attainable. A definite change in the rate of decomposition of volatile solids and COD seems to occur between 48F and 56F. (Schmitt-Iowa State)

### 0589-A7, A8, F6

**VOLATILIZATION OF NITROGEN-CONTAINING COMPOUNDS FROM BEEF CATTLE AREAS,**

Nebraska Univ., Lincoln. Agricultural Experiment Station.
L. F. Elliott, G. E. Schuman, and F. G. Viets.
Soil Science Society American Proceedings, Vol 35, p 752-755, 1971. 4 fig, 10 ref.

Descriptors: *Farm waste, *Ammonia, Fertilizer, Pasture, Crop response, Land use, Dust, Cattle.
Identifiers: *Acid trap, *Cattle feedlot, Distillable-nitrogen, Temperature-dependent, Aliphatic amines, Corn stubble.

The release of NH3 plus steam-distillable organic N compounds to the atmosphere from a small beef feedlot and a pasture was measured. Acid traps placed next to the feedlot and 0.8 km from the feedlot averaged 148 and 16 kg/ha per yr NH3 plus steam-distillable organic N compounds, respectively. The same traps averaged 21 and 3.3 kg/ha per yr, respectively, or organic N compounds that were not recovered by the 3 min steam distillation procedure. Feedlot disturbances, such as manure mounding, increased volatilization of N compounds. Ammonia plus steam-distillable organic N compounds trapped near a cattle pasture and cropland averaged 15 and 11 kg/ha per yr, respectively. Organic N compounds not recoverable by the 3-min steam distillation were very low in the areas. Normally, steam distillation values represent only NH3; however, in this case, other N-containing compounds were distilled over and titrated as NH3. (Bundy-Iowa State)

### 0590-A1, A8, B2, B3, D3, E2, F1, F2

**THE MISSOURI APPROACH TO ANIMAL WASTE MANAGEMENT,**

Missouri Univ., Columbia. Dept. of Agricultural Engineering.
R. M. George, M. R. Peterson, C. G. McNabb, J. W. Robbins, and G. B. Garner.
Missouri Water Pollution Board and Extension Division, University of Missouri - Columbia, MP232/71/1M, p1-65. 21 tab.

Descriptors: *Farm waste, *Lagoon, *Design standards, Aeration, Filtration, Oxidation, Waste disposal, Irrigation, Design, Sprinkler irrigation, Farm management, Swine, Cattle, Anaerobic bacteria, Soil disposal fields.
Identifiers: *Soil-plant filter, System management, Solid manure.

Livestock producers have asked for guidelines on animal waste management that will be feasible and enduring. With these facts in mind, staff engineers of the Water Pollution Board held a series of meetings with staff members of the Extension Division and Department of Agricultural Engineering of the University of Missouri-Columbia, to develop guidelines for disposal of waste from confinement feeding operations. The information and design guidelines are intended primarily for the use of personnel in agencies concerned with animal waste management systems, including detailed information on the components; that is, settling basin and a detention basin. Lagoon systems were outlined giving component parts and sizing with some cost estimates. Guidelines were also given for final waste disposal, including tankwagons and irrigation from pits and lagoons. The effects of these systems on the surroundings were also discussed. (Bundy-Iowa State)

### 0591-A2, A3, A4, A9, B1, C2, F2, F4

**AGRICULTURAL POLLUTION OF THE GREAT LAKES BASIN,**

Deputy Minister, Ontario, Department of Agriculture and Food.
Allen Cywin, David Ward.
Agriculutral Pollution of the Great Lakes Basin, Environmental Protection Agency Water Quality Office, combined Report by Canada and the United States 13020, July, 1971. p. 117S, 4 fig. 50 tab, 22 ref.

Descriptors: *Farm Waste, runoff, nutrients, pesticides, herbicides, chemicals, Fertilizers, eutrophication, Waste disposal, chloride, nitrogen, phosphorus.
Identifiers: *Great Lake Basin, Canada, United States.

This report is intended to be a State-of-the-Art document concerning abatement of pollution of the Great Lakes Basin, as specifically influenced by agricultural and related sources. It was compiled by technical personnel, from appropriate fields in universities and governmental departments in Canada and the United States. Primarily it relates to the identification of the impact of agricultural and related activities on the pollution of the Great Lakes Basin. The major constituents of these non-point sources of pollution which were studied included: 1) runoff and release of nutrients, pesticides, and herbicides and degradation by-products as a consequence of the application of agricultural chemicals; 2) runoff of pollutants from animal and poultry production operations and from associated animal waste management structures and lands used for ultimate disposal; 3) sedimentation resulting from current land use practices, including land influenced by agricultural activities and by local, state and federal activities on public lands, highways and parks. Also under study was the scope of current planning, advisory and regulatory fubctions of the United States and Canadian Governments. The findings of some of the basic research conducted to date by both Nations, and the substance of the programs is one of motivating development of more comprehensively effective and universally applicable methodology for the management of wastes from agricultural and related activities, and the amelioration of the invaluable water resources throughout the Great Lakes Basin. (Bundy - ISU).

### 0592-A4, A5, A8, A12, F1, B4, E2

**PLANT NUTRIENTS AND ANIMAL WASTE DISPOSAL,**

Connecticut Agricultural Experiment Station, New Haven.
Charles R. Frink.
Connecticut Agricultural Experiment Station Circular 237, May 1970. 10 p, 1 tab, 1 fig, 13 ref.

Descriptors: *Farm wastes, *Waste disposal, *Environmental effects, *Public health, *Nutrients, *Connecticut, Sewage treatment, Fertilizers, Nitrogen, Dairy industry, Phosphorus.
Identifiers: *Plant nutrients.

Plant nutrients released to the aquatic environment permit the growth of abundant weeds and algae and complicate present efforts to provide clean water for Connecticut citizens. These nutrient sources include domestic sewage, animal wastes, fertilizers used on both farm and lawns, and nitrogen oxides from high temperature combustion. Although the economic return from the plant nutrients in farm manure is marginal at best, we can no longer afford the consequences of regarding manure simply as waste to be disposed. Continuing efforts should be made to keep adequate land area in crops. Methods of assessing the human health hazard from the disposal of farm wastes should be examined. Research on methods for storage and handling farm manure should be continued, with the ultimate aim at storage and distribution system so that manure is applied to growing crops and not to bare or frozen soil. Research should be continued on new agronomic practices to improve the uptake by the crop of the nutients in the applied manure. (Parker-Iowa State)

### 0593-A4, D3, F2

**ANIMAL WASTE MANAGEMENT.**

Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971. The Airlie House, Warrenton, Virginia, 205 p.

Descriptors: *Farm wastes, Legislation, Cattle, Lagoons, Oxidation lagoons, Waste disposal, *Water pollution sources.
Identifiers: *State legislation, Animal waste management.

This proceeding represents a record of the first meeting that was ever co-sponsored by the U.S. Department of Agriculture, Environmental Protection Agency, Council of State Governments, National Association of State Universities and Land Grant Colleges, and National Association of State Departments of Agriculture. The purpose: to focus on a problem with which they all have an interest and responsibility. There is no doubt of the public concern in a cleaner environment, including clean streams and waterways. At the same time, food requirements increase with the growing population and this has resulted in heavier concentration of livestock and poultry production which are contributing to the pollution of our streams. Thus it is the animal waste management becomes a matter of public concern. Under such circumstances the farmer and rancher who raise livestock and poultry are subjected to both Federal and State laws and regulations. This symposium provided an opportunity for these different interest groups to meet together and share experiences, knowledge, and concerns and hopefully to come up with recommendations that will help assure attainment of our environmental objectives. (Bundy-Iowa State)

### 0594-A1, A4, A6, E2, F2

**IMPROVED CONTROL OF ANIMAL WASTES,**

Department of Agriculture, Washington, D.C.
J. P. Campbell.
In: Animal Waste Management Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 7-9.

Descriptors: *Farm wastes, Permits, Local governments, Regulation, Odor, Water pollution, Fertilizers.
Identifiers: *State laws.

The management of animal waste requires immediate attention. Animal wastes in this country are one of the significant sources of waste in our agricultural industrial-commercial-domestic complex. Fortunately, most of the waste is disposed on the land and does not constitute an environmental pollution threat. The problem stems from increased demand for meat and the modern farming techniques. Eighty to 90 percent of swine, poultry, and broilers are raised in concentrated areas. Where this production is in close proximity to urban, recreational, and other areas heavily used by

people, problems of odors, insects, rodents, and dust can arise. Stream pollution can be a problem even in more remote areas. A successful attack on the problem of animal wastes requires cooperation among USDA, the Environmental Protection Agency, State and local agencies, and private enterprises. The prevention of agricultural pollution must be based on atechnology that has been thoroughly tested and proved as (1) economically feasible for producers, (2) safe with reference to the quality of products, and (3) protective of the public's rights to a clean environment.
(Bundy-Iowa State)

### 0595-A4, A5, A6, A7, A8, A10, A12, F2

**ANIMAL WASTE MANAGEMENT AND THE ENVIRONMENT,**
Environmental Protection Agency, Washington, D.C. Office of Categorical Programs.
D. D. Dominick.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 11-14.

Descriptors: *Farms wastes, Odor, Local governments, Regulation, Water pollution, Feed lots, Legislation, Water Quality Act.

In a report to the President in 1969, entitled 'Control of Agriculture - Related Pollution,' prepared by the Department of Agriculture and the Office of Science and Technology, it was indicated that animal wastes resulting from confined livestock feeding operations created one of the country's three main agricultural pollution problems. The other two pollution problems related to agriculture are caused by irrigation return flows and sediment-laden runoff. These feedlot pollution problems could have been minimized if care had been taken in locating the feedlot. Most states have long-standing public health and nuisance laws that, theoretically, govern livestock and poultry operations with regard to flies and other disease vectors, odors, and dust. However, these statutes do not address the whole spectrum of air, water, and land pollution caused by feedlots. The Environmental Protection Agency has recently set up a Rural Wastes Section in the Office of Water Programs. This section is devoted to agricultural pollution problems, and will be addressing the overall problems of animal wastes. It will be developing guidelines for control, such as determining how much treatment is necessary, and will be providing direction in training and research.
(Bundy-Iowa State)

### 0596-A2, F2

**SUMMARY OF EXISTING STATE LAWS,**
National Association of State Departments of Agriculture, Washington, D.C.
W. S. Cath.
In: Animal Waste Management; Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House. Warrenton, Virginia, p. 17-18.

Descriptors: *Farm wastes, Runoff, Regulation, Pollution, State governments, *Feedlots.

Registration of new feedlots is a part of published regulations. In some states existing feedlots are required to register within a specified time. In other states, existing feedlots are not notified of pollution potential and someone calls this to the attention of the pollution control authority. When this occurs, the control authority requires the operator to register the feedlot and to provide the necessary information. In some states feedlots would not have to register because of the size limitation but can registerif they prefer to do so. A state has responded to the animal waste runoff problem in one of the three following manners: either, developed regulations concerning feedlots construction, have control through other existing regulations such as water quality standards or public health requirements, or no specific regulations are considered applicable at this time.
(Bundy-Iowa State)

### 0597-A2, A4, A5, A6, A7, B1, F2

**STATE REGULATIONS PERTAINING TO LIVESTOCK FEEDLOT DESIGN AND MANAGEMENT,**
Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.
W. F. Schwiesow.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 19-25, 1 tab.

Descriptors: *Farm wastes, Runoff, Water Quality Act, Regulation, Odor, Permits, Water pollution, *Feedlots.

Uniformity of livestock feedlot design and management regulations is desirable so feedlot operators in one state do not have an advantage over operations in another state. Information is being made available to governmental authorities and other interested people in an endeavor to assist in obtaining a degree of uniformity. Interest in the quality of environment has led to many requests for information on state regulations pertaining to livestock feedlots. A summary of the material received may be categorized as follows: (1) regulations concerning feedlot construction, (2) control through other existing regulations, such as water quality standards or public health requirements, (3) no specific regulations that are considered applicable. Definitions for feedlots vary from state to state. Some states define a feedlot as any livestock confinement area where vegetation suitable for livestock consumption does not grow. Other states specify a minimum number confined at any one time. In most states, a penalty is charged for violation of regulations. Penalties range from $10 to as high as $1,000 fine. All 50 states have water quality standards which have been wholly or partly approved by the federal government. Recently passed legislation on air quality standards will cause the development of additional regulation for feedlot construction and management.

### 0598-A4, A5, F1, F2

**MODEL STATE STATUTE FOR ANIMAL WASTE CONTROL,**
Council of State Governments, Washington, D.C.
R. D. Conrad.
Council of State Governments, Washington, D.C.

Descriptors: *Regulation, *Legal aspects, *Farm wastes, *Standards, Confinement pens, Permits, State governments, Civil law, Effluents, Water quality control, Inspection, *Feedlots.
Identifiers: Effluent standards.

A model state statute for animal waste control is presented in an attempt to develop an effective legislative control. Operations which are in compliance with the statute are presumed not to constitute a nuisance. The statute establishes minimum animal numbers in confinement for an operation to be subject to the permit programs. It also establishes that permits shall be needed for the operation and construction of a livestock operation with more than the minimum animal numbers. The statute designates how a permit may be revoked, allowing the operator an opportunity for a hearing. The state legislation should provide protection to those in compliance from harassing legal action and provide stability in administration.
(Dorland-Iowa State)

### 0599-B3, F2

**THE MINNESOTA SCENE LIVESTOCK FEEDLOT, WASTE CONTROL, PROGRESS – PROBLEMS,**
Minnesota Dept. of Agriculture, St. Paul.
R. M. Dennistoun.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 33-35.

Descriptors: *Farm wastes, Regulation, Permits, Livestock, *Minnesota, Feed lots.
Identifiers: Minnesota Pollution Control Agency, Permit applications.

Regulations for the control of waste from livestock feedlots, poultry lots, and other animal lots were developed and officially adopted in April, 1971 by the Minnesota Pollution Control Agency. These regulations were developed to comply with the specific policy and purpose of the State of Minnesota in regard to solid waste control as set forth be Minnesota Statutes. The Agency has prepared 'Permit Application' forms which are to be completed by each operator who plans to 'CONSTRUCT' AND/OR 'OPERATE' A LIVESTOCK FEEDLOT, POULTRY LOT OR OTHER ANIMAL LOT. The application includes those existing feedlots that are 'noncomforming' lots, which means that they do not meet the standards or criteria of some solid waste regulations.
(Bundy-Iowa State)

### 0600-A4, A5, A10, A11, B1, F2

**STATE OF OKLAHOMA ACTIVITIES IN ANIMAL WASTE MANAGEMENT,**
Oklahoma Board of Agriculture, Oklahoma City.
B. R. Gowdy.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 37-39.

Descriptors: *Farms wastes, Waste disposal, Regulation, Permits, Feedlots, Livestock, *Oklahoma, *Water pollution control.
Identifiers: *Feed Yard Act, Oklahoma, Board of Agriculture.

The Oklahoma Legislature, in 1969, recognized the potential problem of animal waste disposal and enacted a 'Feed Yards Act,' with administrative responsibility in the State Board of Agriculture. A 'feed yard' was defined as an area where more than 250 head of livestock were being fed for slaughter and in which there was no growing vegetation intended for livestock feed. The law requires the feed yard operator to (1) provide adequate control of pests, (2) provide reasonable methods for the disposal of animal excrement, (3) provide adequate drainage from the feed yard premise of surface waters falling upon the area occupied by the feed yard so as not to pollute any stream, lake, river or creek, (4) provide adequate veterinarian services to detect, control, and prevent the spread of livestock diseases, (5) have available for use at all necessary times, mechanical means of scraping, cleaning, and grading feeding yard prmises, (6) provide weather-resistant aprons adjacent to all permanently affixed feed bunks, water tanks and feeding devices, and (7) conduct feed yard operations in conformity with established practices of the industry as approved by regulations adopted by the Board.
(Bundy-Iowa State)

### 0601-B1, F2

**PROPOSED ANIMAL WASTE POLLUTION CONTROL LEGISLATION IN NORTH CAROLINA,**
North Carolina Univ., Chapel Hill. Inst. of Government.
M. S. Heath, Jr.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Manage-

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ment, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 41-43.

Descriptors: *Farm wastes, Regulation, Permits, Waste disposal, Feed lots.
Identifiers: Proposals.

North Carolina is considering legislation on the subject of animal waste control and management. During the recently concluded 1971 legislative session, a bill proposing a survey and planning process leading to administrative controls was considered but not approved. North Carolina, within the past year, has developed three separate proposals involving legislation on animal waste management and control. The first proposal, a draft bill cast in the familiar form contemplating regulation through permits for all animal or poultry producing units, never was formally introduced for legislative consideration. The second proposal, retaining the general rule-making power of the original draft but substituting a survey and planning phase for permit requirements, was introduced very late in the 1971 legislative session and died in committee. The third proposal, contemplating a study of animal waste management and control by the legislature's interim study commission, was adopted. (Bundy-Iowa State)

### 0602-A2, B1, F2

**STATE OF VIRGINIA ACTIVITIES IN ANIMAL WASTE MANAGEMENT,**
Virginia State Water Control Board, Richmond.
L. G. Lawson.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 45-47.

Descriptors: *Farm wastes, Runoff, Waste disposal, Livestock, Feed lots, Legislation, *Virginia.
Identifiers: Point source discharge.

The Virginia State Water Control Law, first enacted in 1946, was amended by the 1968 and 1970 general assemblies to broaden and strengthen the authority of the Water Control Board. The Board's powers to regulate municipal and industrial waste discharge are well defined and the law specifically spells out procedures for certification of such discharge. The Virginia pollution control law can be summarized as follows: (1) The present state water control law applies primarily to point source discharge. (2) Standards have been approved pertaining to non-discharging lagoons, and the procedures for issuing these types of certificates are well-defined. (3) The present state law does not adequately apply to diffuse sources of pollution. (4) Legal procedures involving animal waste have proved workable in the past. (5) There has been excellent cooperation from the other agencies in the state that are involved with animal waste. (Bundy-Iowa State)

### 0603-A2, B2, D3, E2

**EFFLUENT DISCHARGE GUIDELINES AND ANIMAL WASTE MANAGEMENT TECHNOLOGY,**
Environmental Protection Agency, Washington, D.C. Office of Research and Monitoring.
H. Bernard, J. Denit, and D. Anderson.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971. The Airlie House, Warrenton, Virginia, p 69-83, 7 fig, 7 tab, 10 ref.

Descriptors: *Farm wastes, *Pollution abatement, *Treatment, Confinement pens, Aeration, Aerobic treatment, Biological treatment, Digestion tanks, Disposal, Farm lagoons, Organic loading, Soil disposal fields, Runoff, Feed lots, Oxidation lagoons.
Identifiers: *Zero discharge, Bio-filter.

We have arrived at the 'age of the feedlot.' More animals are housed, more feed consumed, and more meat produced in any given restricted locale than ever before. In addition to the consumable products, feedlots now produce upwards of 1.5 billion tons of raw manure annually. Environmental impact notwithstanding, under these situations the physical problem of merely keeping the pens, barns, or houses even reasonably clean can be overwhelming. The Environmental Protection Agency research effort is being directed at developing and demonstrating an array of waste management procedures which effectively 'close the loop' against waste discharges. Essentially the effort is to provide farmers with the ability to apply the concept of 'Zero-Discharge' of waste flows. Several possible solutions are presented, a 'spray-runoff' concept, an oxidation ditch, and the 'barriered landscape water renovation system.'

### 0604-A2, A4, A5, A6, A7, A8, B2, E2

**STATUS OF DAIRY CATTLE WASTE TREATMENT AND MANAGEMENT RESEARCH,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
A. C. Dale.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 85-95, 6 tab, 3 fig.

Descriptors: *Farm wastes, *Dairy industry, *Runoff, Environmental sanitation, Liquid wastes, Fertilization, Odors.
Identifiers: *Field spreading.

Dairy-cow herds are proportionately small, averaging about 30 to 40 cows per farm. Although the trend in size is upward, the rate of increase is quite low, and it appears an average herd size of 70 to 80 cows may be reached about 1990. Dairyman have generally done a good job of returning their wastes to the soil. Sanitarians and other health officers that visit grade A dairys have probably had some influence. Liquid handling is now being readily accepted and adapted to the dairy operation, but handling the manure as a semi-solid is still the preferred way. Typically farm acreages are more than 1/2 acre per dairy cow, thus sufficient land is available for adsorption and utilization of the wastes produced without polluting the soil, water or air. Runoff from outside feeding floors appears to be the most difficult problem confronting dairymen. Lagoons are the most satisfactory method of intercepting such runoff, but the excess supernatant must be irrigated onto land and not permitted to overflow into water resources. Aeration can be used to control odors emanating from lagoons. (Schmitt-Iowa State)

### 0605-A2, A4, A5, A7, A8, B1, E2

**CATTLE FEEDLOT POLLUTION,**
F. G. Viets.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 97-105, 2 tab, 13 ref.

Descriptors: *Farm wastes, *Confinement pens, *Runoff, Groundwater, Fertility, Soil properties.
Identifiers: *Land spreading, Zoning.

Per capita beef consumption in the United States has increased 3.5% per year for the last 20 years. This coupled with the apparent profitability of large integrated feeding and slaughtering operations indicate that feedlots will grow larger and not smaller. We have never experienced such a concentration of wastes on so small an area as some of our high density feedlots. Because stream and lake pollution from runoff is now prohibited, engineers are challenged to design facilities that minimize runoff or dispose of it economically and, hopefully, beneficially. The solution to the problem is to return the solid waste to the land in sufficient amounts for near maximum production of crops without waste of the animal feces resource. Underground water pollution appears to be a mostly local phenomenon. Widespread contamination of aquifers does not appear probable. Most of the unsolved problems lie in the air pollution area. The significance of increased levels of ammonia in the air to surrounding crops and lakes needs further study. Only about one tenth of the land needed to produce foodstuffs for cattle is needed for productive waste disposal. Zoning appears to be one of the best solutions to the feedlot problem. Such zoning should include provision for adequate land for manure and runoff disposal.
(Schmitt-Iowa State)

### 0606-A2, A7, B2, B3, D1, D3, E2

**POULTRY WASTE MANAGEMENT,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. C. Loehr.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971. The Airlie House, Warrenton, Virginia. p 107-110.

Descriptors: *Farm wastes, *Poultry, *Waste storage, Eutrophication, Drying, Odors.
Identifiers: *Field spreading.

In most areas of the United States, if an egg producer does not have anywhere from 15 to 30 thousand birds under his control, he is not a major egg producer. The major egg producers usually have production complexes around three hundred thousand birds. In the general commercial house of today, the wastes are defecated through the cages to pits below the cages. Anaerobic conditions occur in the pits and when the wastes are spread, odors are released. All alternatives in storing wastes include either aeration or drying combined with land disposal. It is extremely unlikely that the quality of aeration systems can be made such that the resultant effluent can go directly into any body of water. The place to put agricultural wastes is back on the land. The problem of nutrient control is another factor which requires concern when investigating alternative approaches for agricultural waste management. In the case of nitrogen removal, ammonia released to the atmosphere is not the best approach because of the environmental problem that can result when it comes down. This demonstrates the need to determine overall rather than piecemeal solutions.
(Schmitt-Iowa State)

### 0607-A3, A4, A6, B2, B3, B4, D1, D2, D3, E2

**SWINE WASTE MANAGEMENT,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
A. J. Muehling.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971. The Airlie House, Warrenton, Virginia. p 111-119, 7 fig, 2 tab, 9 ref.

Descriptors: *Farm wastes, *Waste disposal, Farm lagoons, Waste storage, *Runoff, Irrigation practices, Confinement pens.
Identifiers: *Field spreading, Pasture and recycling.

In the 10 Corn Belt states where over 80% of the hogs were sold in 1964, the number of farms selling hogs declined 27% from 1959 to 1964, but the number of hogs sold increased 6%. The adoption of slatted floors has done much to influence the trend toward confinement by reducing or almost eliminating handcleaning and making it possible to pump and handle the wastes with mechanical equipment. The confinement operator has all the wastes confined, so he only needs to adapt a suitable method of disposal to avoid pollution. Due to high nutrient strength as well as high BOD concentration, it appears swine wastes must be returned to the soil. Due to dispersion, hogs on pasture have a low water pollution potential unless they have access to a stream. Swine production systems using solid floors and bedding has high pollution potential if part of the floor is uncovered. The major problems with spreading liquid manure from storage pits are the odors immediately after spreading and danger from runoff if spread on rolling land or frozen ground. Lagoons seldom purify liquids so that they may be released into a natural watercourse. Strong odors are associated with anaerobic lagoons. Although oxidation ditches are virtually odorless, the effluent is not purified to pollution control standards. Hydraulic manure removal minimizes odors but some type of recycling system is normally required. Dehydration, incineration, and composting are not feasible at this time. (Schmitt-Iowa State)

### 0608-B2, B3, D2, D3, E2, E3, E4, F5

**RECYCLING OF ANIMAL WASTES,**
Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.
R. G. Yeck, and P. E. Schleusener.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971. The Airlie House, Warrenton, Virginia, p 121-127, 2 fig, 3 tab, 18 ref.

Descriptors: *Farm wastes, *Reuse, Fertilization, Nutrition, Phosphorus, Nitrogen.
Identifiers; *Recycling.

With much concern over upsetting the earth's delicate ecological balance, we seek the ideal of having all earthly activities fit into one mammoth recycling system. The present system of animal production is inefficient as it fails to take advantage of the feed value left in waste and the wastes are considered an environmental contaminant. Land recycling is currently the best available practice and will probably continue as a prime method for recycle for several years. Some recycling processes have feed as their only product, some produce nonfeed by-products such as methane gas, industrial chemicals, or water. The actual feed value of a specific animal waste is dependent on the waste used, the species to which it is fed, and the process used. The total protein output for any process will, of course, be limited by the nitrogen that was initially in the animal waste. Other constituents of value in animal waste include calcium, phosphorus, starch, and structural polysaccharides. Addition of sodium hydroxide or sodium peroxide increases the digestability of wastes significantly. Ensiling mixtures of manure and grasses seems to have much potential as a refeeding process. Lagooning, hydroponics, insect culture, earthworm culture, fish culture, algae production, yeast production, and single cell protein culture are other processes that might prove to be acceptable economical recycling processes. (Schmitt-Iowa State)

### 0609-A11, A12, C2, C3, E3, F2

**REGULATORY ASPECTS OF RECYCLED LIVESTOCK AND POULTRY WASTES,**
Food and Drug Administration, Rockville, Md. Bureau of Veterinary Medicine.
J. C. Taylor.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 129-131. 4 ref.

Descriptors: *Farm wastes, *Reuse, *Regulation, Legal aspects, Inter-agency cooperation.
Identifiers: *Refeeding, Poultry litter.

The current Food, Drug, and Cosmetic Act of 1938 prohibits interstate commerce in adulterated or misbranded foods and drugs. On September 2, 1967 the Food and Drug Administration published Section 359, which is a formal statement of policy under subchapter A, Title 21 of the Code of Federal Regulation. This section states that the FDA has not sanctioned and does not sanction the use of poultry litter as a feedstuff for animals although it has been recoded to Subpart B of Part 135, Section 135.104. This policy statement is considered to be a general statement applying to all waste products proposed as a component of the diet of animals. The reasons given are that wastes may be expected to contain drugs and antibiotics or their metabolites and that disease organisms may be transmitted through the wastes. The Bureau of Veterinary Medicine has received authorization to contact representatives of the Environmental Protection Agency, the U.S. Dept. of Agriculture, the National Institutes of Health, and the Association of American Feed Control officials in an attempt to better coordinate the efforts of agencies concerned with recycling wastes. The three basic catagories of information desired on waste products submitted to the FDA for review are (1) establishing nutritive value, (2) determining safety to animals and (3) determining food from these animals is safe for man.
(Schmitt-Iowa State)

### 0610-A3, A4, A5, A9, F1, F2

**WATER POLLUTION AND THE FARMER,**
Congress, Washington, D.C.; and House, Washington, D.C.
F. Schwengel.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 133-135.

Descriptors: *Farm wastes, *Runoff, *Government finance, Costs, Waste disposal, Pesticides.
Identifiers: Financial return.

The definition of pollution might be 'An unfavorable alteration of our surroundings manifested by a degradation of the physical, chemical, and biological characteristics of the associated land, water and air.' Agriculture is concerned with at least four major sources of water pollution: sediment, animal wastes, nutrient runoff from fertilizer use, and pollution from pesticides. There are at least two primary reasons that farm and non-farm industries have neglected certain aspects of waste disposal. First, control measures demand an added investment without a commensurate financial return, and second, changing production practices have made it more difficult to dispose of wastes. Despite the magnitude of agricultural pollution, funding by Congress continues at a modestly inadequate rate. Only a little more than $100 million a year will be spent on watershed development projects during the next few years, whereas a funding rate of $500 million annually is needed to accomplish the objectives of minimizing agricultural run-off, silting, and other sources of pollution. If we do not address ourselves to the agricultural pollution problem, we will not achieve our objectives. (Schmitt-Iowa State)

### 0611-B1, F1, F2

**U.S.D.A. TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS,**
Department of Agricultural, Washington, D.C. Science and Education.
T. C. Byerly.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 139-141.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Water resources development.
Identifiers: *Agricultural Research Service, Cooperative State Research Service, Economic Research Service, Soil Conservation Service.

Three research agencies of the Department of Agriculture provide technical and financial assistance. These include the Agricultural Research Service, the Cooperative State Research Service, and the Economic Research Service. The Soil and Water Conservation Research Division of the Agricultural Research Service is responsible for such things as air pollution and water pollution by feedlots. The engineering group of this division is constantly seeking new structures that can contain, divert, or reduce pollution. The animal husbandry group looks into the possibility of recycling waste as feed. The Cooperative State Research Service administers about a million dollars worth of funds annually throughout the states on pollution control research. The containment, diversion, reduction, and utilitization of waste are areas of concern. The Economic Research Service is responsible for evaluation of alternate methods of waste management and the evaluation of the economics of scale, organization of feedlot enterprises, and the efficiency of feedlot production. Agencies that provide the bulk of technical assistance as well as some financial assistance include the Soil Conservation Service, the Farmers Home Administration, the Farmer's Cooperative Service, the Agricultural Research Service, and the Extension Service. The Soil Conservation Service has information available for all problems in the area of structure design. The Extension Service is a very good information delivery system as it is present in every county. (Schmitt-Iowa State)

### 0612-E1, F1

**PROVIDING TECHNICAL AND FINANCIAL ASSISTANCE TO FARMERS FOR ANIMAL WASTE DISPOSAL SYSTEMS,**
Farm Credit Administration, Washington, D.C.
G. L. Swackhamer.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 143-145.

Descriptors: *Farm wastes, *Credit, *Loans, Financing, Economic feasibility, Pollution abatement.
Identifiers: *Farm Credit System, Federal Land Bank, Production Credit Association, Banks for Cooperatives.

The Cooperative Farm Credit System is a privately owned and managed system of credit services to farmers, ranchers, and their cooperatives. It is comprised of Federal Land Banks, Production Credit Associations, and Banks for Cooperatives. The funds used by the System are obtained from the sale of bonds and debentures to private investors through a Fiscal Agency, and is regulated by the Farm Credit Administration, an independent agency. It appears desirable that some guidelines for decisions involving pollution control facilities be established, since the amount of credit required to finance animal waste systems is sizable and varies widely, and frequently, credit-worthy farmers have encountered difficulty in financing waste systems. Farm Credit banks have concluded that cooperatives have more waste management problems than individuals, relocation is often the method of resolving pollution problems, expenditures for waste disposal systems frequently lead to cost overruns; both lenders and borrowers are frequently ignorant of current laws and regulations, no single method of handling animal wastes is best in all cases, and amounts for pollution control are often intertwined with total credit requests and may not receive adequate attention. Reconciliation of social benefit-cost issues with private investment-production decisions is producing new considerations for both lenders and borrowers.
(Schmitt-Iowa State)

### 0613-A2, A4, A10, A11, A12, F1, F2

**TECHNICAL AND FINANCIAL ASSISTANCE**

**FOR THE CONTROL OF ANIMAL WASTES,**
Environmental Protection Agency, Washington, D.C. Office of Water Programs.
K. M. Mackenthun.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 147-149.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Water resources development, Federal Water Pollution Control Act.
Identifiers: Solid Wastes Disposal Act.

In confined animal feeding, manure becomes a liability for both the operator and the public, as it is a repository for diseases and pests and it is a catastrophic polluter when it reaches a waterway. Runoff from cattle feedlots can be toxic to aquatic life, remove needed oxygen from the water, and supply food for the development of nuisance biological pests. The Environmental Protection Agency has a number of grants for research and demonstration and technical assistance activities that are applicable to the control of animal feedlot wastes. Grants are authorized under Section 6 (b) of the Federal Water Pollution Control Act with the prime objective to develop by the late 1970's techniques for the complete elimination of point-source wastes, as well as to develop and demonstrate technology for the renovation of wastewaters for reuse. Technical assistance is available in the Office of Water Programs' Division of Technical Support and in comparable support groups within the ten regions of the Environmental Protection Agency. Both the Solid Waste Disposal Act and the Federal Water Pollution Control Act provide grants to assist state, interstate, municipal and inter-municipal agencies and organizations in development of plans and programs for solid waste and water pollution control. Regional EPA Administration should be contacted for Agency assistance. (Schmitt-Iowa State)

### 0614-B1, F1

**SMALL BUSINESS ADMINISTRATION PROGRAMS TO PROVIDE FINANCIAL AND TECHNICAL ASSISTANCE TO SMALL FIRMS IN SOLVING PROBLEMS RELATIVE TO ANIMAL WASTE DISPOSAL,**
Small Business Administration, Washington, D.C. Office of Financial Assistance.
A. E. Armstrong.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 151-152.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Water resources development, Pollution abatement.
Identifiers: *Small Business Administration.

It is the policy of the Small Business Administration to make, participate in, or guarantee loans to small firms for any worthy business purpose, which includes waste disposal of any kind. Consideration is given to increasing loan amounts requested to provide for acquisition and installation costs of waste disposal or waste treatment facilities with the same approach being permitted in respect to air and solid waste pollution. It is possible for the SMA to launch new business operations such as those in the processing or recycling waste field, but they are very difficult to handle. If an existing business wishes to purchase or install recycling or reprocessing equipment this would be treated as normal business expansion. Since SBA is a lending agency, it is concerned with credit criteria or requirements. As any other lender, it is interested in the character of its borrowers and in repayment ability, management ability, capitalization, and collateral. For lending purposes a business qualifies as a small business, generally, if it retails less than $1 million annually. The classification of a manufacturing concern is based on the number of employees and can range from less than 250 to less than 1,500 depending upon the industry. SBA is not empowered to make any type loan or guarantee to agricultural enterprises, being limited in its activities to commercial operations. (Schmitt-Iowa State)

### 0615-B2, F1

**FINANCIAL ASSISTANCE FOR THE CONSTRUCTION AND IMPROVEMENT OF IRRIGATION SYSTEMS,**
New Mexico State Government, Santa Fe. Office of State Engineer.
J. C. Yates.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 153-155.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Water resources development, Pollution abatement.
Identifiers: *Community ditches, Soil Conservation Service, Agricultural Stabilization and Conservation Service, Four Corners Regional Commission.

Funds for programs relating to water supplies for irrigation, and projects for the construction and improvement of irrigation systems are from a trust fund account established by the Congress of the United States (Act of Congress 30 Stat. 484) in 1898 to the Territory of New Mexico. For that portion of the Southwest that was acquired by the United States from Mexico, the community ditch is an institution peculiar to the native people, and the customs governing community ditches are written into law. Through the cooperation of the Agricultural Stabilization and Conservation Service, the Soil Conservation Service, the Four Corners Regional Commission, and local ditch organizations, nearly all ditches have been improved through concrete ditch lining, plastic and concrete pipelines and appurtenances for the distribution of water, works for flood protection of irrigation structures, construction of diversion dams, ditch headings and sluiceways, and improvement of impoundment dams. In addition to grants and loans to community ditches, the Interstate Stream Commission has loaned to irrigation and conservation districts about $1.8 million for lining ditches, leveling land, and undertaken similar conservation practices. The success of the cooperative irrigation systems improvement program may encourage others to seek acceptable Federal-State-Local programs for animal waste management. (Schmitt-Iowa State)

### 0616-A3, A4, B2, B4, C2, F1

**THE LAKE MENDOTA WATERSHED PROJECT,**
Wisconsin Univ., Madison.
D. G. Last.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 163-167, 1 ref.

Descriptors: *Farm wastes, *Administrative agencies, *Waste storage, Government supports, Pollution abatement.
Identifiers: *Agricultural Stabilization and Conservation Service, Soil Conservation Service, Rural Environmental Assistance Program, Lake Mendota.

In 1966, the Lake Mendota Problems Committee prepared a report entitled, 'Report on the Nutrient Sources of Lake Mendota.' Evidence was presented showing 30% of the phosphorus which entered the lake stemmed from runoff from agricultural land on which manure had been spread. Potential for this type of runoff was particularly high during the winter when snow cover or frost made the soil impermeable. It was decided lake improvement could be accomplished by recommending methods for handling animal wastes that decrease water pollution. Through the cooperation of the Agricultural Stabilization and Conservation Service, the Soil Conservation Service, and the University of Wisconsin Extension office, storage structures were built on a cost-sharing basis for those livestock facilities needing them. Despite the voluntary basis for this project, it is felt the Rural Environmental Assistant Program's stated goal: 'To improve the quality of life for all people by preventing or abating environmental pollution; providing the maximum public benefit; and conserving the land and related natural resources,' has been accomplished. (Schmitt-Iowa State)

### 0617-B2, D1, D3, E3

**THE ROLE OF EXTENSION IN POLLUTION ABATEMENT IN VIRGINIA,**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Cooperative Extension Service.
R. L. Wesley.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 169-171.

Descriptors: *Farm wastes, *Poultry, *Administrative agencies, Lagoons, Anaerobic digestion, Waste treatment, Water reuse, *Virginia.

Cooperative Extension Service at Virginia Polytechnic Institute and State University is quite heavily involved in assisting the poultry industry in Virginia with pollution abatement. Areas of assistance with top priority include the design, construction, and operation of waste disposal systems for poultry processing and rendering plants, and conduction of on-campus short courses at VPI and SU on pollution abatement. Poultry processing waste is a suitable substrate for biological degradation by both aerobic and anaerobic bacteria. The effluent from processing plants contains the proper bacterial flora so that when subjected to adequate liquid-solid separation procedures, 80% to 95% BOD removal can be achieved with the use of a series of oxidation ponds or lagoons. A grease and grit trap, an anaerobic digester, an aerobic polishing lagoon, and/or a mechanical aerator are the necessary ingredients for reliable disposal. If human sewage is also involved, final effluent chlorination is sometimes required. Temperature and depth of the lagoon are two critical factors for effective decomposition. At 10, 20, and 30 degrees Centigrade, 32, 89, and 96 percent of the solids have been removed. Predominant bacteria that will appear in a lagoon are temperature dependent as evidenced by the various colors produced as the temperature changes occur. Additional processes will need to be added to the design in order for the treated effluent to be recycled. (Schmitt-Iowa State)

### 0618-E1, F3

**COMMUNICATION IS THE KEY TO SUCCESSFUL ACTION,**
E. W. McMunn.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 173-176.

Descriptors: *Farm wastes, *Communication, *Technology, Waste disposal, Pollution abatement, Political aspects, Education.

Developing new technology is important; but knowledge is of little value until it is put to use. And it will never be used unless it reaches the minds of those who need to know. We spend relatively little time studying how to communicate in an effective manner. Non-farm people are increasingly calling the tune where our vital interests are concerned, due to population shifts. These people no longer understand agriculture and many couldn't care less. Our job is to build understanding with non-farm people. Since the whole store of knowledge is incomprehensible, we must choose a few basic ideas and concentrate on these. Questions we must decide include, (1) What, really, is the message we wish to tell. (2) Why do we want to tell it. (3) Who do we want to reach. (4) Who should do the telling. (5) What 'vehicles' must be employed to transport our message. Something similar to a task force needs to make these decisions where people with a common interest unite to tell a story. This task force must represent a wide range of interests, be aware of human nature in planning communication strategy, plan communications programs on the basis of meaning to the people we're trying to reach, have a relevant message and then deliver it in terms the audience will understand. Certainly, the most important single element must be a communications plan. (Schmitt-Iowa State)

### 0619-F1, F2, F3

**REPORTS AND RECOMMENDATIONS OF WORKING GROUPS.**
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 179-185.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Economic feasibility, Pollution abatement.
Identifiers: Extension Service.

Six different subject categories were discussed by various working groups of the National Symposium on Animal Waste Management. Recommendations have been made for each subject category and are as follows: (1) Information Programs - A national agricultural-related pollution problem inventory should be funded and carried out through existing agencies; create a national data inventory bank on waste management research; establish a task force to develop a system for providing animal waste management information to farmers and to the public. (2) Education and Training Program - The Extension Service should receive additional resources and be more concerned with public affairs; formal education should be emphasized both in the private sector and in government agencies. (3) Technical Assistance - An advisory committee with some legal status should be established to advise legislators; livestock and poultry producers should form a common group to represent their interests. (4) Financial Assistance - Tax credits should be allowed for pollution abatement measures; relocation assistance should be available; cost-share programs should be expanded. (5) Research and Development - On-farm field research should be increased and supported financially. (6) Legislation and Regulation - Flexibility should be maintained; An ad hoc animal waste coordinating committee should be appointed in each state to improve cooperation among all groups and develop well-defined goals. (Schmitt- Iowa State)

### 0620-E1, F1, F3

**RECOMMENDATIONS OF NATIONAL MILK PRODUCERS FEDERATION.**
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 187-188.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Pollution abatement, Waste disposal, *Milk, *Dairy industry.
Identifiers: *Rural Environmental Assistance Program.

The regulation of individual livestock operations should be based on individual adherence to regional waste management guidelines. Regional guidelines should serve as national standards to be enforced at the state level through an appropriate state certification program. The development of regional guidelines should be predicated on the principle that an overall conservation plan is essential for the individual farm or ranch enterprise embarking on a pollution prevention program. It is essential that animal waste management guidelines become a part of a systematic approach to develop an overall conservation plan because of the interrelationship of waste utilization, recycling, or disposal, with overall farm operations, available soils and appropriate vegetation. Each waste management system must be tailored to the needs of individual owners or operators within the capability of soils and plant cover at the site. A contract arrangement between USDA and individuals is most effective in assisting farmers to comply with regional guidelines. An additional $200 million per year over current REAP funding should be appropriated for expenses of a program of research, financial and technical assistance to agricultural waste and pollution producing enterprises.
(Schmitt-Iowa State)

### 0621-A6, A11, B3, C2, D1, D2, E3, F1

**POULTRY POLLUTION: RESEARCH RESULTS,**
Michigan State Univ., East Lansing. Agricultural Experiment Station.
C. C. Sheppard.
Research Report 152 Farm Science, C.C. Sheppard, editor. 64 p. November, 1971.

Descriptors: *Farm wastes, *Odor, *Poultry, Nutrients, Diets, Fertilizer, *Waste disposal, Analysis.
Identifiers: *Dried Poultry waste, Air ventilation, Supplemental protein, Feed efficiency.

The drying and feeding of poultry waste was reviewed as to the economic value, nutrient value, and the effects on animals fed dried poultry manure. The topics include: (1) economics of dried poultry waste as a feed ingredient or a fertilizer, (2) feeding dehydrated poultry waste to dairy cows, (3) the relationship of drying temperature to total crude protein in dried poultry waste, (4) drying of poultry manure in a cage-layer house, (5) dried poultry waste as a protein source for feedlot cattle. (6) the metabolizeable energy value of dried poultry waste, and (7) the effects of continually recycling dehydrated poultry waste on the performance of SCWL laying hens. A table presents results of analyses of samples of dried poultry waste. (Bundy-Iowa State)

### 0622-A11, C2, D1, D2, E3

**EARLY EXPERIMENTS AT MICHIGAN STATE UNIVERSITY INVOLVING THE USE OF CHICKEN MANURE,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
H. C. Zindel.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science. November 1971. p 2-3.

Descriptors: *Farm wastes, *Poultry, Nutrients, Antibiotics, Diets, *Waste disposal.
Identifiers: Fresh chicken droppings, Oven dried.

The original poultry science research at Michigan State University involving the use of poultry excreta as a feed ingredient was performed in 1954. Drs. David Libby and P. J. Schaible used poultry manure in research involving antibiotics. They reported that under clean battery conditions, no response was obtained from the drug in the feed. However, when contaminated manure was in the ration, the furazolidone exhibited a pronounced growth response. In 1959, W. K. Warden and P. J. Schaible conducted a series of experiments in which fresh chick droppings were fed to chicks daily in the presence and absence of antibiotics. When fecal matter was fed to chicks, growth rate was depressed below that of the controls, but this depression was not statistically significant. In 1961, J. D. Yates reported that fresh hen feces added to the feed of chicks and poults depressed growth, except in some groups which received a high level of antibiotics. Heated (100 Deg C) fresh hen feces improved the growth rate of chicks which received no antibiotics and turkey poults which received Virgeniamycin in the ration.
(Bundy-Iowa State)

### 0623-E2, E3, F1

**ECONOMICS OF DRIED POULTRY WASTE (DPW) AS A FEED INGREDIENT OR A FERTILIZER,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
H. C. Zindel, and C. J. Flegal.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, November, 1971. p 4-7.

Descriptors: *Farm wastes, *Odor, Drying, Poultry, Fertilizer, *Waste disposal.
Identifiers: *Hens, Tractor and spreader, Dried poultry waste, Recycling.

Several laying hen trials have been conducted using dried poultry waste (DPW) in the diet. If 12.5% or 25% DPW of the total ration were substituted for the same amount of corn on a pound for pound basis, basing the cost of corn at $60 per ton and DPW at $20 per ton, a direct saving of either $5.00 or $10.00 per ton can be realized, respectively. Translating this into savings per dozen eggs, a one cent per dozen eggs savings would be accomplished for 12.5% DPW and a two cents per dozen eggs savings on 25% DPW. Manure disposal via the conventional method of spreading on crop land versus that of drying provides some interesting facts and figures. A flock of 100,000 layers provides 4,563 tons of manure per year (at the rate of .25 lb./bird/day) or 12.5 tons daily. If one assumed it takes 2 days or 16 hr. to clean the house (s) each month (4 week period) and deliver the wet manure to the field for spreading with a tractor and spreader, or deliver to a dryer site for processing, the following facts apply: wet manure value for fertilizer: $2.39 ton; cost of spreading wet manure: $11.96 tons. Difference of $9.57 /ton is the loss to spread on the land.
(Bundy-Iowa State)

### 0624-A11, B3, C2, E3

**FEEDING DEHYDRATED POULTRY WASTE TO DAIRY COWS,**
Michigan State Univ., East Lansing. Dept. of Dairy Science.
J. W. Thomas, and H. C. Zindel.
In: Poulty Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, November, 1971. p 8-11, 2 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, Cattle, Drying, Amino acids, Nitrogen, Protein, *Waste disposal.
Identifiers: Laying hens, Dairy cattle, Dehydrated poultry waste, Milk quality.

Investigators have found that several classes of livestock could derive energy and nitrogen from various animal manures. The digestive system of the ruminant can convert various non-protein-nitrogen sources into amino acids that are useful to the animal. Of the nitrogen in poultry manure, 25 to 75% may be in various non-protein-nitrogen forms. This non-protein-nitrogen in poultry manure may slowly hydrolyze in the rumen and form a very good source of N for ruminants. Dehydrated caged layer feces was fed to milking dairy cows to determine if it could serve as a nitrogen energy source. Consumption of the grain mixture containing 30% dehydrated poultry waste (DPW) was as great as that of cows fed normal grain mixtures after the cows became accustomed to the material. The flavor of the milk from DPW fed cows was scored normal. Dehydrated caged layer feces was successfully used to furnish a portion of the dietary protein and energy in the diet of milking cows. Thus, products similar to that used here could replace 15 to 20% of the dietary protein of ruminants. (Bundy-Iowa State)

### 0625-B5, C2, D1, D2, F6

**THE RELATIONSHIP OF DRYING TEMPERATURE TO TOTAL CRUDE PROTEIN IN DRIED POULTRY WASTE,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. C. Sheppard, C. J. Flegal, D. Dorn, and J. L. Dale.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, November, 1971. p 12-16, 1 fig, 2 tab, 3 ref.

Descriptors: *Farm wastes, *Drying, Protein, Poultry, Feces, *Waste disposal.
Identifiers: Dried poultry waste, Commercial dryer.

Benne from Michigan State University reported laboratory analysis of 77 samples of poultry feces. Fourteen of these were analyzed as a wet product (as received from a poultry house) and 63 had been dried in a commercial dryer, prior to the analysis. The extreme variations in total protein on a dry weight basis of the wet and dried samples are given. The relationship between the temperature at which the feces was dried and the resulting total protein content of the dried poultry waste was investigated. The regression analysis of the data shows there tends to be an inverse relationship between the heat and the resulting total protein. The correlation of drying temperature to the resulting total protein approaches significance. The calculated coefficient was -0.284; -0.288 would indicate significance at the P = .05 level. (Bundy-Iowa State)

### 0626-A6, A7, D1, D2, F1

**DRYING OF POULTRY MANURE IN A CAGE-LAYER HOUSE,**
Michigan State Univ., East Lansing, Dept. of Agricultural Engineering.
M. L. Esmay, and C. C. Sheppard.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, November, 1971. p 17-27, 2 fig, 3 tab.

Descriptors: *Farm wastes, *Odor, *Poultry, *Drying, Environment, Air pollution, *Waste disposal.
Identifiers: Partial drying, Cage-laying house, Air ventilation.

Odor control is important for today's poultry enterprises. Partial drying of the poultry excreta within a few hours after deposit is one way to minimize odor production and thus air pollution. This investigation deals with the means and related economics of partially drying fecal matter in the poultry house with supplemental electrical energy. Over 2000 Btu of electrical energy were required to evaporate each additional pound of water from the fecal matter accumulated over the energized dropping pit panels. This is less than 50% efficient use of electrical energy applied to the floor panels below the cages. The cost was about one cent per additional pound of water evaporated from the droppings, (1 kwh equals .3420 Btu/hr and each kwh costs between 1.5 to 2.0 cents). Removing additional water from the droppings during winter months may not be worth the cost, unless the undesirable threshold is imminent and dwellings are near by. During hot weather conditions, removing part of the fecal matter moisture immediately after depositcould be critical in controlling odors. High temperatures accelerate odor production; and hot weather vaporization with energized panels could be much more efficient in utilizing electrical heat. (Bundy-Iowa State)

### 0627-A11, B3, C2, E3

**DRIED POULTRY WASTE AS A PROTEIN SOURCE FOR FEEDLOT CATTLE,**
Michigan State Univ., East Lansing. Dept. of Animal Husbandry.
H. F. Bucholtz, H. E. Henderson, C. J. Flegal, and H. C. Zindel.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, November, 1971. p 28-31, 2 tab.

Descriptors: *Farm waste, *Poultry, Drying, *Cattle, Nutrient, Protein, *Waste disposal, Efficiency.
Identifiers: Dried poultry waste, Feedlot cattle, Supplemental protein, Feed efficiency.

Waste disposal in animal agriculture has become not only a management problem, but also an environmental pollution concern to people associated with the animal industries. The poultry industry tried to dry poultry waste to abate the waste disposal problem. Due to the high protein content of fresh poultry waste (as high as 50% CP), research was conducted using dried poultry waste (DPW) as a protein supplement for chickens and cattle. However, data on recycling DPW through cattle is limited. The value of DPW as a supplemental protein source for feedlot cattle was determined. The source of protein had a large and highly significant effect on average daily gain. Average daily gain for the soy supplemented group (3.35 lb) was significantly greater than the group supplemented with DPW (2.75 lb), 1/2 DPW - 1/2 urea (3.03 lb). However, this was not significantly greater than the urea supplemented group (3.10 lb). No significant differences in average daily gain occurred between the groups supplemented with urea, 1/2 DPW - 1/2 soy or 1/2 DPW - 1/2 urea. Steers refused to consume the DPW portion of ration. (Bundy-Iowa State)

### 0628-A11, E2

**THE METABOLIZEABLE ENERGY VALUE OF DRIED POULTRY WASTE,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
D. Polin, S. Varghese, M. Neff, M. Gomez, and C. J. Flegal.
In: Poultry Pollution: Michigan Agricultural Experiment Station, Research Results, Research Report 152 Farm Science, November 1971. p 32-44, 1 fig, 5 tab, 15 ref.

Descriptors: *Farm wastes, Drying, *Dehydration, Poultry, Nutrients, Nitrogen, Diets, *Waste disposal.
Identifiers: *Dried poultry waste, *Metabolizeable energy.

Metabolizeable energy (M.E.) values of 0.35 and 1.35 kcal/g (159 and 614 kcal/lb) of material were found for cellulose and a dried poultry waste (DPW) sample, respectively, when fed to laying hens. The materials were analyzed for M.E. by replacing corn in a practical type layer ration at levels of 8 and 16%. The calories returned to the diet by either DPW or cellulose were determined and compared on the basis of slope ratios to the expected loss caused by the removal of corn. Cellulose at both levels depressed protein, as well as calcium and phosphorus utilization. Protein utilization was not affected by DPW and neither DPW nor cellulose had any effect on the utilization of fat, which averaged almost 90% with all test diets. (Bundy-Iowa State)

### 0629-A11, B3, C2, E3

**THE EFFECTS OF CONTINUALLY RECYCLING DEHYDRATED POULTRY WASTES (DPW) ON THE PERFORMANCE OF SCWL LAYING HENS – A PRELIMINARY REPORT,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, and D. A. Dorn.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, p 45-48, November 1971. 3 tab, 2 ref.

Descriptors: *Farm wastes, Poultry, Drying, Nutrients, Diets, *Dehydration, *Waste disposal.
Identifiers: *Dried poultry waste, Dehydrated feces.

An ultimate goal in poultry production is a closed circuit system in which the only by-product of the system is meat or eggs. The following experiment was conducted to test the concept or recycling the feces within a closed system of egg production for an extended period. Five hundred and eighty-eight commercially grown 20-week-old started pullets were fed diets containing 0, 12.5%, and 25.0% DPW for about 7 mo. The DPW diets were continually recycled, i.e., feed feces dehydrated and placed back in the diets and fed to the same birds in a closed system concept. At the completion of fourteen cycles, the proximate analysis of the DPW from each of the experimental rations was quite similar. There was a trend toward a slight accumulation of calcium and phosphorus. Egg production for the birds fed the control diet and the diet containing 12.5% DPW were similar. Daily feed consumption of the birds fed the control diet and the diet containing 12.5% DPW was similar, but those birds fed the diet containing 25% DPW ate 11.3 g more feed per bird per day than those fed the control diet. (Bundy-Iowa State)

### 0630-C1, C2

**A COMPILATION OF SOME SAMPLES OF DRIED POULTRY WASTE ANALYZED BY DR. E. J. BENNE,**
Michigan State University, Biochemistry Dept., East Lansing, Michigan.
E. J. Benne.
Poultry Pollution: Research Results, Research Report 152 Farm Science, Michigan State University Agricultural Experiment Station, East Lansing, Michigan. November, 1971. pp. 49-63, 1 tab.

Descriptors: *Farm Waste, *Analysis, Poultry, Protein, Dehydration, Moisture content, Calcium, Phosphorus.
Identifiers: *Dried Poultry Waste.

The author compiled data collected from samples of dried poultry waste. A laboratory analysis of 77 samples of poultry feces including 14 samples analysed as a wet product and 63 had been dried in a commercial dryer. The article consists of the one tbale with percents of moisture, protein, PDWB, CA, P, Crude F, EE and NPN. (Bundy - ISU).

### 0631-A6, A7, D1, D2

**ODORS, GASES AND PARTICULATE MATTER FROM HIGH DENSITY POULTRY MANAGEMENT SYSTEMS AS THEY RELATE TO AIR POLLUTION,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel, D. C. Ludington, A. G. Hashimoto, W. E. Burnett, and N. C. Dondero.
Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, April 15, 1969. 106 p, 29 fig, 16 tab, 73 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, *Gases, Ammonia, Hydrogen sulfide, Gas chromatography, Carbon dioxide, Moisture content, Organic compounds, *Air pollution.
Identifiers: *Particulate matter, Soil columns, Odor panel, Soil filtration, *Odor control.

The technological changes which have taken place in livestock production in the last few years to provide economical meat, eggs, and milk have resulted in the concentration of animals under conditions of high density for greater efficiency. This change of management practice has created problems in both waste disposal and the control of odors from these wastes. These odors are particularly obnoxious when either the animal enterprise or the land for disposal of manure is adjacent to urban or resort developments. Results of a two year research project dealing with the detection and control of air pollution from high density poultry management systems are summarized. It covers such subjects as the determination of the chemical nature of the odor of poultry manure; the quantitative determination of odors and gases from poultry manure; the role of particulate matter in air pollution; and odor control methods such as soil filtration, water scrubbing, and chemical treatment. (Bundy-Iowa State)

## 0632-A6, B2, C2

**THE QUALITATIVE DETERMINATION OF THE ODOR QUALITY OF CHICKEN MANURE,**
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
W. E. Burnett.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 2-17, April 15, 1969. 6 fig, 2 tab, 18 ref.

Descriptors: *Farm wastes, *Odor, *Poultry, Gas chromatography, Nitrogen, Ammonia, Hydrogen sulfide, Organic compounds, *Air pollution.
Identifiers: Odor panel, Organoleptic techniques, Liquid poultry manure, Odorous organic compounds.

A combination of gas chromatographic and organoleptic techniques was used to determine the chemical compounds responsible for the offensive odor of accumulated liquid poultry manure. In addition to the odorous gases, ammonia and hydrogen sulfide, a number of odorous organic compounds were identified, including the C2 to C5 organic acids, indole, skatole, diketones, mercaptans, and sulfides. Of these, organoleptic tests indicate that the organic acids, mercaptans, and sulfides were important malodorous components. Skatole was also implicated as an important malodorous component, due to its characteristic strong, fecal odor. Amines evidently play an important role in the odor as well.
(Bundy-Iowa State)

## 0633-A6, C1, C2, F6

**THE QUANTITATIVE DETERMINATION OF THE ODOR STRENGTH OF CHICKEN MANURE,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel, and W. E. Burnett.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 18-39, April 15, 1969. 5 fig, 3 tab, 12 ref.

Descriptors: *Farm wastes, *Odor, Waste dilution, Poultry, Ammonia, Moisture content, *Air pollution.
Identifiers: *Vapor dilution, *Liquid dilution, Manure strength, Cage-laying hens, Olfactory threshold test, Fresh manure.

Strength is a characteristic of an odor that can be measured. In contrast to characteristics such as quality and occurrence which rely only on individual opinion, strength allows associating a number with an odor. The method of liquid dilution and the method of vapor dilution have been investigated. Odor strength of animal manures can be measured on a laboratory basis by the liquid dilution and the vapor dilution methods. The vapor dilution method looks at the odors arising from the manure while the liquid dilution method is concerned with the odors in the manure or the odor potential of the manure. Odor was found to have a higher strength from mixed manure than from unmixed manure. Odors arising from diluted or 'liquid' manure have an odor strength comparable with the odors arising from undiluted manure. However, the quality of the odor from 'liquid' manure is very offensive compared with the ammonia-like odor from undiluted manure. Reduction in the moisture content of manure reduces the odor strength and the odor offensiveness. The odor strength for fresh manure by liquid dilution is a dilution of the order 1000. This value can increase to as high as 35,000 depending on conditions. Odor strength measurements by vapor dilution are only valuable for comparison purposes, since odor production flow rates are unknown values. (Bundy-Iowa State)

## 0634-A6, A7, B5, C2

**ANALYSES OF GASES ENCOUNTERED IN A COMMERCIAL POULTRY HOUSE,**
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
W. E. Burnett.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 40-46, April 15, 1969. 1 tab, 30 ref.

Descriptors: *Farm wastes, *Poultry, Ammonia, Carbon dioxide, Hydrogen sulfide, Organic compounds, Odor, Air pollution, Sufur dioxide, Humidity, Temperature, *Air pollution.
Identifiers: Chemical detection.

Little is known about the concentration of gases in poultry houses. Past research has centered mainly on the ammonia and carbon dioxide levels in poultry confinement housing. Ammonia concentrations as high as 100 ppm have been found in some commercial poultry houses under the conditions of reduced ventilation and reuse of litter. Some factors which are believed to affect the concentration of gases in poultry buildings are temperature, humidity, ventilation, bird population and the manure management system, as well as frequency of waste removal. A number of existing techniques for the measurement of industrial air pollution are applicable to the analysis of gases encountered in commercial poultry houses. The wet chemical (absorption) method of gas detection was used to determine the concentrations of aliphatic aldehydes, hydrogen sulfide, sulfur dioxide and ammonia in a commercial poultry house with fluid waste handling. The average gas concentrations in ppm were 0.032, 6.98, 0.0036, and 1.13 for aliphatic aldehydes, hydrogen sulfide, sulfur dioxide, and ammonia respectively. None of the gas concentrations were above the maximum allowable concentration (MAC) for humans, but the level of $H_2S$ was well above its odor threshold of 0.13 ppm. As the concentrations of gases showed considerable variation from sampling to sampling, more work is needed to correlate gas concentrations with such factors as temperature, ventilation rate and manure management system.
(Bundy-Iowa State)

## 0635-A6, A7, B4, C2

**GASES AND ODORS FROM UNDILUTED AND DILUTED CHICKEN MANURE,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
D. C. Ludington, A. T. Sobel, and A. G. Hashimoto.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 47-64, April 15, 1969. 10 fig, 5 ref.

Descriptors: Farm wastes, Poultry, Odor, Carbon dioxide, Methane, Ammonia, Hydrogen sulfide, Waste dilution, *Air pollution.
Identifiers: Odor strength.

The odors and gases produced by and released from chicken manure stored and handled in the undiluted and diluted state have been observed to be considerably different. This difference was most obvious when the stored manure was being moved or agitated. More cases of air pollution attributed to egg producing poultry farms have been reported since the diluted system of storage and handling was put into practice. The release of some of the gases and odors from stored chicken manure under the undiluted and diluted state was investigated. Significant differences occurred between the odor and gas production and release by undiluted and diluted chicken manure. Carbon dioxide release from the undiluted manure was slightly greater than the release from diluted manure. The difference may not be significant. The undiluted system released significantly greater quantities of $NH_3$ than the diluted system. Chicken manure stored in a diluted state produced significantly more $H_2S$ and $NH_3$ than manure stored in an undiluted state. The release of $H_2S$ from the diluted system was about twice that released from the undiluted manure. Both releases were well below threshold. The odor released from the diluted manure, while the manure was quiescent, was in general, more obnoxious than that from the undiluted manure. When the manure was agitated at the end of the tests, the difference was much more pronounced. (Bundy-Iowa State)

## 0636-A6, A7, C2

**PARTICULATE MATTER,**
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
W. E. Burnett.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as they Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 65-70, April 15, 1969. 1 tab, 10 ref.

Descriptors: *Farm wastes, *Odor, *Poultry, Gas chromatography, Circulation, *Air pollution.
Identifiers: Odor panel, *Particulate matter, Filter pads, Poultry dust.

Modern commercial high density poultry houses contain high concentrations of airborne particulate matter. Concentrations as high as 1.16 mg per cubic foot of air have been reported. Regarding quantities of particulates produced, amounts as high as 1 lb/day/1000 birds have been reported. The particulate matter consists of fecal matter, feed, feathers, and epidermal fragments, litter, and dust brought into the poultry house by the ventilation system. Particulate matter collected by high volume samplings of a commercial poultry house atmosphere revealed that the particulates carried a 'chicken house' odor. Gas chromatographic analyses of the volatiles carried by the particulates revealed the presence of individually odoriferous compounds. Large quantities of particulate matter are probably expelled from poultry houses by ventilation fans. Whether particulate matter plays a significant role in ambient odors from poultry houses should be investigated further since the particulates represent a retentive source of odors. (Bundy-Iowa State)

### 0637-A6, A8, C2, D1, E2

**SOIL FILTRATION TO REMOVE ODORS,**

Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
W. E. Burnett, and N. C. Dondero.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 71-86, April 15, 1969. 3 fig, 8 tab, 14 ref.

Descriptors: *Farm wastes, Odor, Organic compounds, Poultry, Soil, Ammonia, Hydrogen sulfide, Filtration, *Waste treatment, *Air pollution.
Identifiers: *Soil filtration, Soil columns, Liquid dilution method, Odor panel, *Odor control.

Modern, high-density poultry operations in which there are accumulations of manure cause nuisances in populated areas because of the foul odors discharged to the atmosphere by forced ventilation. The feasibility of removing poultry odors from ventilation air by soil filtration was investigated. The soil column effectively removed manure odors. Odors were removed by only 6 inches of soil under the conditions of test. The ability of the soil to remove ammonia decreased markedly as the soil dried. Soil columns remove ammonia as long as the soil remains moist. Ammonia breaks through those columns when dry. The manured soil removed more ammonia than the untreated soil. (Bundy-Iowa State)

### 0638-A6, B2, C2, D2

**ODOR CONTROLS BY CHEMICAL TREATMENT,**

Cornell Univ., Ithaca, N.Y. Dept. of Food Sciences.
W. E. Burnett, and B. Gormel.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 87-97, April 15, 1969. 5 fig, 1 tab, 12 ref.

Descriptors: *Farm wastes, *Odor, Poultry, Ammonia, Hydrogen sulfide, Carbon dioxide, *Waste treatment, *Air pollution.
Identifiers: *Chemical treatment, Mechanical control, *Odor control.

The various methods of odor control include elimination by mechanical, physical, or chemical means, and modification, usually by chemical means. Chemical means was reviewed in an attempt to eliminate or modify poultry manure odors. The emphasis is on abatement of odor from liquid management systems. Offensive manure odors can be effectively masked by the use of an effective masking agent dispersed in Mosquito Larvae Oil in liquid poultry manure pits. Mosquito Larvae Oil appears to do an effective job in dispersing the masking agent over the surface of the liquid manure. Applications of 5 ml and 10 ml of making agent to the tanks of liquid manure were considered to be impractical because of the relatively short time these additions were effective in masking the odors, especially after the proportion of manure solids increased in the water.
(Bundy-Iowa State)

### 0639-A5, A8, B2, E2

**USING SOIL FILTRATION TO REDUCE POLLUTION POTENTIAL OF LAGOON EFFLUENT ENTERING GROUND WATER SYSTEM,**

Iowa State Univ., Ames.
C. E. Beer, and J. K. Koelliker.
Iowa State Water Resources Research Institute, Ames, Completion Report ISWRRI-41, August, 1971. 32 p, 4 fig, 2 tab, 23 ref. OWRR A-021-IA (1).

Descriptors: *Irrigation efficiency, *Denitrification, *Nitrogen, *Farm wastes, Chemical oxygen demand, *Nitrates, Ammonia, *Lagoons, Waste treatment, *Waste disposal, Anaerobic conditions, *Waste water treatment, Application, *Effluents, Iowa, Biochemical oxygen demand, Chemical oxygen demand, *Phosphorous, Organic matter, *Filtration, Infiltration, *Soil profiles, Sprinkling.
Identifiers: *Soil filtration.

Swine lagoon effluent was applied to soil for final treatment. The active soil profile appears to offer great potential as a final treatment media for partly treated animal wastes and cattle feedlot runoff. Effluent sprinkled on a grass-covered soil profile reduced COD, nitrogen, and phosphorus concentrations 79-95, 40-80, 95-99 percent, respectively over a 3-year period. Loadings ranged from 13.9 to 48.1 in. of lagoon effluent per May-October season. Removal of COD was attributed to biological activity and physical filtration in the upper inches of the soil. Phosphorus reduction resulted from chemical activity of the clay fraction near the soil surface. Nitrogen reduction was attributed primarily to denitrification deeper in the soil profile. The organic matter in the soil served as the carbon source for denitrification rather than the lagoon effluent. Organic matter content of the lower region of the soil profile was reduced and nitrogen removal by denitrification decreased. For disposal fields that are operated primarily for BOD removal, about 24 in. per year can be applied in most areas of Iowa. In areas where nitrate concentration in the percolate is of concern, applications should be limited to 600 lb/acre of nitrogen per season.

### 0640-A5, B1, B4, D1, D2, E2, F2

**HANDLING LIVESTOCK WASTE,**

North Dakota State Univ., Fargo. Dept. of Agricultural Engineering and Animal Science.
G. L. Pratt, D. W. Johnson, and M. L. Buchanan.
North Dakota Farm Research, North Dakota State University Reports on Environmental Quality, Vol 4, No 28, p 22-24, March-April, 1971. 1 tab.

Descriptors: *Farm wastes, *Treatment, *Water quality control, Oxidation lagoons, Aeration, Disposal, Drying, Farm lagoons, Filtration, Dewatering, Separation techniques, Waste storage, Confinement pens, Settling basins, Runoff.
Identifiers: *Groundwater pollution, Feedlots, Slatted floors.

Congress has been developing legislation since 1948 to prevent water pollution. The Federal Water Quality Act of 1965 was the culmination of this development. The act provided that states could set water quality standards and administer them. In 1967 the North Dakota legislature adopted a comprehensive water pollution control act. These acts have necessitated research on managing and disposing of livestock wastes. The major phases of manure handling are collection, storage, treatment, and disposal. Various methods of collection, storage, treatment, and disposal are listed with their relative advantages and disadvantages. However, spreading on cropland has been the standard method to dispose of livestock manure for a long time. Research to date indicated that it is still the most practical method for preventing pollution. (Dorland-Iowa State)

### 0641-A4, C3

**BACTERIAL COUNTS OF A SECTION OF THE RED RIVER – SUMMER, 1970,**

North Dakota State Univ., Fargo. Dept. of Bacteriology.
M. C. Bromel.
North Dakota Farm Research, North Dakota University Reports on Environmental Quality, Vol 4, No 28, p 60-61, March-April, 1971.

Descriptors: *Water pollution, *Coliforms, *Waste dilution, North Dakota, Cultures, Oxygen demand, Treatment facilities, Salmonella, Clostridium, Shigella, Fishkill.
Identifiers: *Red River, Bacteriological analyses, Coliform count.

Numerous surveys by state and federal agencies from 1935-1969 indicate that the Red River has become progressively more polluted as the municipal and industrial population along its banks increase. During the summer of 1970, from June 8 through July 28 an intensive biological and bacteriological survey of the Red River was undertaken. Surface and bottom water samples were collected from a boat with a Van Dorn water sampler. Biological and chemical analysis on each sample included the following determinations: dissolved oxygen, pollution, number of animals sensitive to pollution, and total suspended solids. The bacterial counts, especially the coliform counts, were far over the 5,000/100 ml allowable by North Dakota and Minnesota standards for potable or recreational water. There was consistently present a high concentration of bacteria in the Red River at the Fargo intake averaging 500,000 bacteria per milliliter of water. The dissolved oxygen level at several sites was below the two-state standard (5 ppm) minimum. The presence of Shigella dysenteriae in the Wild Rice River when the coliform count was very low (500/ml) is remarkable since this form of Shigella is very rarely found in the U.S. (Dorland-Iowa State)

### 0642-A2, A3, A4, A5, A9, B2, B3, D1, D2, D3, E2

**AGRICULTURAL WASTES: PRINCIPLES AND GUIDELINES FOR PRACTICAL SOLUTIONS.**

New York State Coll. of Agriculture, Ithaca.

Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. 172 p.

Descriptors: *Farm waste, *Water quality control, Pesticides, Eutrophication, Liquid waste, Surface runoff, Dehydration, *Waste water treatment, Oxidation lagoons, Incineration.
Identifiers: Composting, Land spreading.

The purpose of this 1971 Conference was to take the knowledge obtained from research and field experience and convert this knowledge into information which can be used to solve the problems in agricultural waste management. Another benefit of this proceedings may be to point out areas where the information is weak or missing. This could be helpful in planning more appropriate research in the future. (Bundy-Iowa State)

### 0643-A1, A9, F2, F4

**AGRICULTURE:S RESPONSIBILITIES IN A CLEAN ENVIRONMENT,**

New York State Dept. of Environmental Conservation, Albany.
R. W. Pederson.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York, p 1-5.

Descriptors: *Farm wastes, *Pollution abatement, *Pesticides, *Water law ecosystems, Contaminants, Water quality control.

Agriculture's responsibilities in the all-out effort to achieve and maintain a clean environment are to recognize and understand its relationships to other facets of the economy, to seek still greater knowledge on the 'hows' of waste management, and to apply the principles and guidelines that lead to practical solutions. Agriculture is an interlocked part of our society and culture, and our environmental problems are becoming more severe very rapidly. The new New York Department of Environmental Conservation has set goals of achieving greater effectiveness in correcting yesterday's costly mistakes, and of preventing the future degradation of our environment. Effective steps in pollution prevention mean a substantial commitment of manpower and financial resources, individual and corporate investments that aren't immediately profitable, new attitudes, and environmental conscience, and more government controls. The Department of Environmental Conservation's activities can affect land use by pesticide controls, by water supply and sewage controls for new subdivisions, controls over stream alteration, and controls over industrial plant location through permit issuance for water discharges and licensing of new air emissions. The total ecological system is very delicately interwoven and such things as the domino effect of DDT poisoning can be a very real threat to our ecology. (Schmitt-Iowa State)

### 0644-A2, A4, A5, B2, C2, D3, F2

**ENVIRONMENTAL QUALITY AND PRODUCTIVITY,**
Environmental Protection Agency, Washington, D.C. Water Quality Office.
J. D. Denit.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 6-11, 2 tab, 5 ref.

Descriptors: *Farm wastes, *Water quality control, *Surface runoff, Lagoons, Eutrophication, Water pollution sources, Water law.

World needs demand expansion of the already immense American livestock industry. The problem which now confronts the industry is the adverse impact of production wastes on the environment, particularly water quality. Due to the fragmented nature of earlier studies, a definite pattern of animal waste pollution has emerged only in the last two years. Fish kills from feedlot-runoff in Kansas in 1964 was an indicator of the twenty-four kills in twelve states in 1969. The combination of production oriented and traditional zero-cost, waste management philosophies is now leading to severe pollution problems. Anaerobic lagoons are designed on raw waste strength instead of runoff quality. Farmers have not been informed of state Water Quality Standards or their responsibility in meeting them. Even though organic waste loads from lagoons are higher than raw domestic wastes, the concentrations of nitrogen and phosphorus are of greater significance, because no industry is more dependent upon a pure water supply than agriculture. In conserving water quality, the agricultural operator is engaging in notable self-service and making an investment in survival.
(Schmitt-Iowa State)

### 0645-A9, F1. F2

**PESTICIDES AND PEST CONTROL IN THE FUTURE,**
Cornell Univ., Ithaca, N.Y. Dept. of Entomology.
D. Pimentel.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 12-14, 1 ref.

Descriptors: *Farm wastes, *Pesticides, *Agricultural chemicals, *Pest control, Ecosystems, Water quality control, Regulation.

One billion pounds of pesticides were applied in the U.S. during 1970. Seventy percent was for farm use and the remaining for public and governmental use. Ninety-nine percent of the 200,000 species of plants and animals were non-target species, but many of these were affected. The Environmental Protection Agency has taken over the responsibility of pesticide regulation from the Dept. of Agriculture. In 1965, the overall return for every dollar invested in insect control with pesticides was 4 to 5 dollars, while the return per dollar invested in bioenvironmental control was 30 dollars. Development research in bioenvironmental control is slow, tedious, and costly. Prescription use of pesticides could have the advantages of expert advice, rapid distribution of new information from government agencies, more accurate control of the amounts used, and the establishment of a precautionary public attitude. Some pesticides would be banned and some applied only by state-licensed custom sprayers. Aware of the insidious destruction by pollution, the aim would be to keep the advantage of technology, but reduce the associated environmental hazards.
(Schmitt-Iowa State)

### 0646-A3, A4, A5, A12, C2, E2

**FARM LAND RUNOFF,**
Cornell Univ., Ithaca, N.Y. Dept. of Natural Resources.
R. T. Oglesby.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 15-19, 11 ref.

Descriptors: *Farm wastes, *Runoff, *Nitrogen compounds, *Phosphorus compounds, Fertilizers, Water quality, Eutrophication, Soil erosion, Water pollution sources.

Agricultural wastes and many materials in agricultural usage are translocated to aquatic systems where some of them cause significant problems. Nitrogen, applied as fertilizer or from manures, leaks from agricultural activities in quantitites sufficient to promote nuisance algal growth in receiving waters where this element is a limiting factor, and many, through accumulation in groundwaters, constitute a health hazard as well. Large quantities of phosphorous are lost in runoff, primarily through erosion of soil-phosphorus particles. The significance of this form of phosphorus in stimulating algal growth is not fully understood but is probably not high. Organically bound phosphorus, such as that occurring in animal wastes, may add significant amounts of this element in a form available to plants. (Schmitt- Iowa State)

### 0647-A1, A4, A7,B2, D2, E1

**ENVIRONMENTAL PROBLEMS IN THE FOOD PROCESSING INDUSTRY,**
Cornell Univ., Ithaca, N.Y. Agricultural Experiment Station.
D. L. Downing.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971. p 20-24, 6 tab.

Descriptors: *Farm wastes, *Water pollution sources, *Liquid wastes, Waste water disposal, Industrial wastes, Air pollution.

The food processing industry ranks fifth in the U.S. in the volume of liquid wastes generated, producing about 700 billion gallons annually. This waste contains a high amount of suspended solids of which only part is settleable; therefore, the national food industry ranks first in the amount of suspended solids released to the environment. The BOD5 of food-plant effluent is normally several thousand ppm compared with a few hundred for typical municipal sewage. The pH of food processing wastes range from below 5.0 for sulphur dioxide bleaching processes to about 12.0 for lye peeling of vegetables. Pigments in cannery wastes are very difficult to degrade, often persisting after passing through a municipal treatment plant. Olive, pickle and sauerkraut brine range up to 15% in sodium chloride content. Unlike some industries where waste products can be utilized, most solid wastes from canneries have to be hauled to land-fill type operations. Transmission of plant pathogens is a major reason wastes are not normally spread on the cropland. Adding to the waste problem is the fact that the food industry uses about 50% of all package utilization. Air pollution and noise pollution are still other problems it will take much ingenuity to solve.
(Schmitt-Iowa State)

### 0648-A3, A4, A8

**FERTILIZER PRACTICES WHICH MINIMIZE NUTRIENT LOSS,**
Cornell Univ., Ithaca, N.Y. Dept. of Agronomy.
D. J. Lathwell, W. S. Reid, and D. R. Bouldin.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, Syracuse, New York. p 25-35, 6 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Fertilization, *Nutrient requirements, Water pollution sources, Crop response, Rates of application, Soil erosion.

Water is the transport agent for nutrients, organic matter, and sediments from agricultural land. The major flow of runoff occurs in the spring when accumulated snow and ice melt. Experimental data demonstrate that the major quantity of nutrient loss occurs during the spring runoff period. The major form of inorganic nitrogen in the soil is usually nitrate, even if ammonium fertilizers are added becuase of the universal occurrence in soil of microorganisms which convert ammonium to nitrate. The nitrate ion is completely dissolved in the soil solution and moves wherever the soil water moves. The nitrate may be leached into the groundwater, into tile drains or into surface runoff. To avoid these losses, moderate amounts of fertilizer nitrogen should be added just before the crop begins its period of minimum growth. If the fertilizer is added too soon, some or most of it may be carried off before the plant can take up the nitrogen. Phosphorus fertilizer reacts rapidly with the soil to form relatively insoluble products. The major source of phosphorus loss from agricultural land is associated with sediment loss. Therefore, control of erosion is essential if phosphorus is to be kept on agricultural land. All of the control measures outlined above are economically feasible. (Schmitt-Iowa State)

### 0649-A3, A4, A6, A8, A10, C2, E2

**LAND DISPOSAL OF MANURE IN RELATION TO WATER QUALITY,**
Cornell Univ., Ithaca, N.Y. Dept. of Soil Science.
S, D. Klausner, P. J. Zwerman, and T. W. Scott.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 36-46, 8 tab, 10 ref.

Descriptors: *Farm wastes, *Surface runoff, *Fertilization, Soil erosion, Water pollution, Eutrophication, *Waste disposal, Waste water treatment, *Nutrients.

Disposal on land is the most practical final placement for farm manure, as it is a source of plant hutruent and organic matter. Nitrogen in manure is very mobile in a soluble form. Phosphorus becomes 'fixed' and is removed largely by the physical removal of soil, organic matter, or manure by surface erosion. Vegetation acting as a sink for incoming nutrients as well as a control of erosion are necessary for control of nutrient removal. Incorporating the manure with the soil shortly after spreading is an important consideration as immobilization of nutrients increases and odor and fly problems decrease. Winter spreading causes numerous problems. Frozen soil is impervious to water and subject to runoff during thaws. Spring applications of manure can pose a threat to water quality if improperly managed. Late in the spring, surface and subsurface flows of water are no longer at maximum levels, thus decreasing the pollution potential. Concrete evidence as to the maximum rates of manure that can be applied without causing a polltuion hazard under most soil and weather conditions is non-existent. Continuing research hopefully can answer unsolved problems of economic means of handling animal wastes. (Schmitt-Iowa State)

### 0650-A4, A9

**GUIDELINES FOR MINIMIZING PESTICIDE POLLUTION,**

Cornell Univ., Ithaca, N.Y. Chemical-Pesticide Program.
R. F. Pendleton, and J. E. Dewey.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 47-51.

Descriptors: *Farm waste, *Pesticides, *Pesticide drift, Pesticide toxicity, Water quality control, Phytotoxicity.

The worst aspects of pesticides are usually the most newsworthy. In order to retain the necessary use of pesticides it is imperative to use all possible means to minimize or prevent their becoming pollutants. Pesticides when properly used are tools. When they move off target or are otherwise misused they become pollutants. They become particularly important as pollutants when they move into water and cause either immediate toxicity to organisms present, or, more seriously, are of a persistent and accumulative nature and move into the food chain. Many factors contribute to pesticide drift; some physical, some climatic. The smaller the droplet and the greater the wind, the greater the drift. The choice of pesticides influence drift damage from toxicity, phytotoxicity, illegal residues, and volatilization. Choosing the right machinery for a particular job is most important. In most cases a short-lived, biologically degradable, non-cumulative compound may be substituted for an environmentally dangerous compound. Poor operational procedures and misuses are probably the greatest contribution to pesticide pollution, which can be greatly reduced through education programs involving pesticide applicator safety and known principles of conservation. (Schmitt-Iowa State)

### 0651-A4, B2, B3, D1, D2, D3, E1, F4

**ANIMAL WASTE HANDLING IN THE UNITED KINGDOM,**

Cornell Univ., Ithaca, N.Y. Dept. of Poultry Science.
C. E. Ostrander.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 52-53.

Descriptors: *Farm wastes, *Dehydration, *Waste water treatment, Aerobic treatment, Anaerobic digestion, Domestic wastes.

The poultry industry in England, Scotland, and Holland is quite different from that in the United States. There are many smaller operations in the 1,000 to 5,000 bird range, they have less mechanization, and they look at quality differently. However, one of the world's largest poultry operations is located near Nottingham, England and produces 60,000,000 broilers a year in addition to maintaining 3,500,000 laying hens. There is much interest in the United Kingdom in dehydration of manure. This is probably due to the fact that they can include dehydrated poultry manure in commercial feed formulations. The United Kingdom is very concerned about water pollution as they depend on rivers for water supply and do not want polluted effluent dumped into them. Holland appeared to be putting fairly potent effluent into drainage ditches. They have tried natural lagoons, but low temperatures and lack of sunshine prevented proper operation. Some are converting to aerated lagoons. Other methods being tried include the Floc-tower system, centrifuging, anaerobic digesting, and aeration in oxidation ditches. They are concentrating livestock, and waste problems are becoming more acute. (Schmitt-Iowa State)

### 0652-B2, B3, D3

**LIQUID WASTE TREATMENT I. FUNDAMENTALS,**

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. C. Loehr.
In: Agricultural Wastes: Principles and Guidelines for Practical Solution, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 54-62, 1 fig, 1 tab.

Descriptors: *Farm wastes, *Aerobic treatment, *Anaerobic digestion, Pollution abatement, *Waste water treatment.

Controlled and uncontrolled biological systems are the major systems used to treat organic wastes. The systems can treat liquid or solid wastes, can be aerobic, anaerobic, or facultative, and can be within controlled structures or unconfined on the land. In biological systems microorganisms utilize the biodegradable wastes for food. Synthesis or growth is affected by the ability of the microorganisms to metabolize the wastes, the temperature and pH of the system, and the presence of adequate nutrients, trace elements, and toxic materials. It is not possible to have a system in which there is no net accumulation of solids with time due to nonbiodegradable material. Bacteria are the most important group of microorganisms followed by fungi, whih re non-photosynthetic multicellular plants. Algae are photosynthetic autotrophs, utilizing sunlight and inorganic compounds to synthesize cells. In aerobic treatment carbon is oxidized to microbial protoplasm and carbon dioxide, while in anaerobic systems some carbon is reduced only to methane. For optimum nitrification a dissolved oxygen concentration of about 2 mg/l is necessary. In general, microbial reaction rates are doubled for every 10 deg C rise in temperature of the waste system. (Schmitt-Iowa State)

### 0653-B2, D3

**LIQUID WASTE TREATMENT II. OXIDATION PONDS AND AERATED LAGOONS,**

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. C. Loehr.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 63-71, 3 fig, 1 tab, 2 ref.

Descriptors: *Farm wastes, *Oxidation lagoons, *Farm lagoons, *Aeration, *Aerobic treatment, Dissolved oxygen, *Waste water treatment.

Oxidation ponds and aerated lagoons are among the simplest liquid waste treatment systems currently used. Bacteria and algae are the key organisms in an oxidation pond, with the active bacterial mass under 50 mg/l. In most oxidation ponds there are ample algal nutrients in the influent carriage water and resulting from becterial metabolism to produce excess oxygen from algal growth. Satisfactory performance depends on the balance between the bacteria and the algae. Oxidation ponds are organic matter generators, since algal cells are produced. Unless algal cells are removed from the effluent of the pond prior to discharge, little reduction in the ultimate waste load will have occurred. Temperature affects the rate of metabolism of microorganisms; thus, the rate at which the pond can be loaded. Loading relationships should be in terms of BOD5 per surface area per day, and generally range from 20 to 50 pounds per acre per day. An aerated lagoon differs from an oxidation pond in that aerobic conditions are maintained by mechanical means, with algae generally not present. Dissolved oxygen should be maintained at 1-2 mg/l with the detention time from 1-10 days. (Schmitt-Iowa State)

### 0654-B2, B5, C2, D3

**LIQUID WASTE TREATMENT III. THE OXIDATION DITCH,**

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. C. Loehr.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 72, 2 fig, 1 tab, 1 ref.

Descriptors: *Farm wastes, *Sewage treatment, *Aerobic treatment, Oxygen demand, Stabilization, Oxidation lagoons, *Waste water treatment.

The oxidation ditch, or Pasveer ditch, is an aerobic biological waste treatment system with a long liquid detention time and adequate mixing. The key components are a continuous open channel and a surface aeration rotor, which mixes the ditch contents and supplies oxygen. Untreated wastes can be added directly to the ditch. The effluent from agricultural wastes normally is not suitable for discharge to surface waters, but is suitable for land disposal. If sufficient oxygen is supplied, odors are negligible. BOD5 reductions of 80-90% can be obtained. Characteristics include low capital cost, ease of operation, and minimum maintenance. The total solids concentration can range up to 4-6%. Because of long detention times, the food to organism ratio is only from .03 to 0.1 lb. BOD per lb. MLVSS (Mixed Liquor Volatile Suspended Solids) per day. Velocities of 1.0 to 1.5 ft./sec. should be maintained to minimize settling. The depth of liquid ranges from 15 to 30 inches with rotor immersion one-fourth to one-third the liquid depth. Livestock oxidation ditch effluent must be kept in aerated holding units or disposed of in a short time to avoid anaerobic conditions and odors. (Schmitt-Iowa State)

### 0655-B2, C3, E3

**ANAEROBIC BIOLOGICAL WASTE TREATMENT SYSTEMS,**

Cornell Univ., Ithaca, N.Y. Dept. of Environmental Engineering.
A. W. Lawrence.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agriculture Waste Management, February 10-12, 1971, Syracuse, New York. p 79-92, 6 fig, 3 tab, 18 ref.

Descriptors: *Farm wastes, *Anaerobic digestion, *Methane bacteria, *Waste water treatment, *Farm lagoons, Pollution abatement.

The anaerobic process, one of the major biological

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wastewater treatment processes, is most effectively applied in the treatment of concentrated wastes, such as those from animal production exceeding 1% organic solids. The anaerobic process converts organic matter to methane and carbon dioxide. The methane can be vented to the atmosphere or burned as a heat source. Microbiologically, the anaerobic process is complex with many species of microorganisms involved. However, the bacteria can be functionally divided into two groups, acid formers and methane formers. The methane producing bacteria are extremely sensitive to environmental change. A typical organic loading rate for a completely mixed tank is .2 lb. volatile solids per day per cubic foot. Completely mixed systems are quite expensive and require extensive operator control, which makes them unattractive for agricultural purposes. The lagoon is probably the most widely used anaerobic process configuration in agricultural waste treatment at this time. Attractions include low capital and operating costs and minimal operating requirements. Anaerobic processes can be designed by either the rational approach which applies to completely mixed systems or the empirical method which is used in designing lagoons. (Schmitt-Iowa State)

### 0656-A12, C3, D2, F1

**CHLORINATION OF WASTEWATER EFFLUENTS,**
Cornell Univ., Ithaca, N.Y. Dept. of Environmental Engineering.

In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 93-101.

Descriptors: *Farm wastes, *Disinfection, *Chlorination, Water treatment, Public health, Waste water treatment, Diseases.

Certain diseases caused by enteric pathogenic microorganisms can be transmitted from infected human and animal sources to susceptible human populations by water supply systems. Examples include typhoid and cholera. Due to water supply and recreational use of our rivers, there is a trend to require disinfection, or chlorination, of sewage and wastewater. Aqueous solutions of chlorine can be prepared from either dissolution of gaseous chlorine or the hypochlorite salts. Chlorine, as a strong chemical oxidizing agent, inactivates the key enzyme systems within the pathogenic microorganism. The process of chlorination is usually controlled by measurement of the chlorine residuals and is called the orthotolidine test. Pathogenic organisms are usually present in very low numbers; therefore, indicator organism used in wastewater is called the coliform group, consisting of bacteria of intestinal origin of warm-blooded animals, the same origin as the pathogens. Coliforms, however, have a longer survival time in natural waters. Factors affecting disinfection include temperature, contact time, concentration, chlorine species present, pH, and type of organism. Cost of chlorination is on the order of one cent per thousand gallons of wastewater, with control of the process being straightforward and relatively simple. (Schmitt-Iowa State)

### 0657-B3, D2, D3, E3, E4

**SOLIDS DESTRUCTION OR SEVERE TREATMENT,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
D. C. Ludington.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 102-106, 1 fig, 1 tab, 3 ref.

Descriptors: *Farm wastes, *Waste water treatment, *Incineration, *Solid wastes, Pollution abatement, Chemical degradation.
Identifiers: Wet-air oxidation process.

There are three basic processes which can be used to destroy solid matter or convert solid matter into liquids or gases. These three processes are (1) biological, (2) chemical, and (3) thermal. A biological process is one which utilizes bacteria to decompose or break down solid matter. These processes can only attack those solids which can be biologically degraded. Biological processes can be subdivided into two categories; aerobic which require the presence of dissolved oxygen, and anaerobic which takes place in the absnece of dissolved oxygen and produces offensive odors as products of destruction. Total reduction for biological destruction is 30-50%. Chemical destruction of solids is a process which chemically oxidizes the solid material in an aqueous solution at high pressure and temperature and in the presence of air but without a flame. The process, also known as the wet air oxidation process, operates at temperatures about 500 deg F and pressures from 150 to 3000 psig and can effectively convert all the volatile solids in solid material into carbon dioxide, water, and nitrogen. Thermal destruction is the rapid oxidation at temperatures 1000 to 1400 deg F, near atmospheric pressure and with a flame. Also known as incineration, this process can convert all the volatile solids to gaseous products and heat. (Schmitt-Iowa State)

### 0658-A6, B4, D1, D2

**MOISTURE REMOVAL,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 107-114, 7 fig, 1 tab, 4 ref.

Descriptors: *Farm wastes, *Dehydration, *Drying, *Absorption, Waste storage, Incineration, Waste water treatment.

Removal of water from animal manures provides many advantages for manure management systems, including a reduction in offensive odor, a reduction in weight and volume, and a change in handling characteristics. The range of ideal moisture content is 10-15%, since ammonia is produced in the 75-15% range, and below 10%, the manure becomes dusty. The possible means of water removal are, (1) mechanical, (2) absorption, and (3) thermal. Mechanical removal consists of using pressure to force the water from manure. Absorption is a functional method of moisture removal as long a sufficient absorption material and air movement is provided. Thermal means of moisture removal can be subdivided into dehydration and drying. Dehydration, the removal of moisture at a temperature considerably greater than ambient, must be accomplished in complex equipment with the added cost of a fuel source. Drying, the removal of water by evaporation at a temperature slightly above ambient, is controlled by, (1) environment, (2) configuration, and (3) air movement. Thickness of manure should be 1/4 inch or less for drying with a maximum air flow of 800 fpm. Dehydration should be considered only if there is a market available for the dehydrated product, or if the cost is considered a treatment. (Schmitt-Iowa State)

### 0659-D3

**COMPOSTING,**
Rutgers - The State Univ., New Brunswick. N.J. Dept. of Soils and Research.
S. J. Toth, and B. Gold.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 115-120, 2 tab, 11 ref.

Descriptors: *Farm wastes, *Artificial use, *Aerobic conditions, *Humus, Thermophilic bacteria, Carbon cycle, Decomposing organic matter.
Identifiers: *Composting.

The production and use of artificial manures or coposts for soil improvement practices is as old as the art of agriculture. Composting can be defined as the process involving the conversion of organic residues into liqnoprotein complexes (humus) via thermophilic organisms under optimum moisture and aeration conditions. In the process, CO2 is evolved and the temperature of the pile may reach 155 to 170 deg F. Air moisture, nitrogen, phosphorus, and potassium are necessary ingredients for composting. Unless sufficient moisture is present the pile will dry out and decomposition will cease. If too much moisture is present or air is excluded, anaerobic conditions are produced and obnoxious odors will result. Microorganisms require nitrogen for their growth so composts made from plant materials with less than 2% total nitrogen will require the addition of either organic or inorganic nitrogen. Small amounts of additional phosphorus and potassium may be needed, with 20 pounds of superphosphate and 10 pounds of muriate of potash usually being sufficient. Any materials containing cellulose can be composted, the only exceptions being plastics and resins with a closed ring structure. Characteristics of ideal compost include dark color, inorganic matter content of 80% or more, moisture content between 10 and 20% total nitrogen from 2.5 to 3.5%, and a pH between 5.5 and 6.5. Due mainly to low organic matter, garbage composting in the United States has been largely unsuccessful. (Schmitt-Iowa State)

### 0660-A11, A12, D3, E2, E3, F1

**UTILIZATION OF AGRICULTURAL WASTES,**
Agricultural Research Service, University Park, Pa.
W. R. Heald, and R. C. Loehr.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 121-129, 49 ref.

Descriptors: *Farm wastes, *Waste disposal, *Water reuse, Fertilization, Artificial use, Waste disposal.
Identifiers: Recycling.

Waste management can be thought of in three categories: the prevention of, the recovery of, or the disposal of wastes. Recovery, or recycling is the return of wastes to its natural state, and along with salvage, or utilization of wastes is potentially the most efficient operation. The land will continue to be the ultimate disposal site for animal wastes, and is considered a recycling process when coupled with crop production. Benefits other than nutrient value include increased infiltration capacity of the soil, and reduced soil erosion resulting from better plant cover. Methods of utilizing animal wastes are composting, energy or methane production and refeeding. Composting is feasible but a market must be developed before the process is financially attractive. In general, the nutritive value derived from animal wastes incorporated in feed rations is greater if the wastes of single stomached animals are added to the feed ration of ruminants and if the ruminant wastes are treated chemically before being added to feed rations. Unknowns related to transmittal of drugs, feed additives, and pesticides to the second animal and to the agricultural product, such as eggs and milk, remain to be classified. A variety of costs must be developed before the value of utilization and recycling can be determined.
(Schmitt-Iowa State)

### 0661-A3, A4, A5, A6, A7, B2, B3, B4, D1, D2, E2, F1

**ODORS AND THEIR CONTROL,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
D. C. Ludington.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 130-136, 1 fig, 1 tab, 12 ref.

Descriptors: *Farm wastes, *Odor, *Poultry, Runoff, Water pollution, Air pollution, Air circulation, Waste treatment.
Identifiers: *Odor control, Soil columns, Cages, Plow-furrow-cover, Oxidation ditch, Chemical treatment, Odor control costs.

The seriousness of odors produced from poultry operations have increased with changes to the 'modern' poultry house. Sources of odors around a poultry operation includes: (a) ventilation air, (b) loading areas and outside storage tanks, and (c) the land after spreading. Controlling odors from these sources can be accomplished to varying degrees by different methods. The following list of odor control methods is an attempt to put these methods in perspective as to success of odor removal. Ranking of odor control methods for the various odor sources: (a) Ventilation air: (1) adequately aerated liquefied manure, (2) moisture removal (moisture content reduced to 30-40% w.b.), (3) frequent (daily) cleaning, (4) chemical treatment (if sufficient chemical is used, this treatment could be higher on the list); (b) Loading area and outside storage tanks: (1) adequately aerated liquefied manure, (2) moisture removal (30-40%), (3) chemical treatment; (c) Land after spreading: (1) adequately aerated liquefied manure, (2) plow-furrow-cover or sub-surface injection, (3) moisture removal, (4) frequent cleaning and spreading (daily), (5) chemical treatment. The final decision on an odor control method must be based upon cost and the local situation. The local situation depends upon nearness of neighbors or degree of odor control necessary. No matter how carefully the method is chosen, if good management and good housekeeping are not followed, the system will fail. (Bundy- Iowa State)

### 0662-A6, B2, B3, B4, D3

**WASTE HANDLING ALTERNATIVES,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. W. Guest.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 137-141, 2 fig.

Descriptors: *Farm wastes, Liquid wastes, Odor, Waste storage, Storage capacity, Aerobic treatment, Oxidation lagoons, Cattle, Poultry, Swine, *Waste water treatment, Waste disposal.
Identifiers: *Semi-fluid material, Manure spreaders.

Methods of handling agricultural manures are changing. The reason--primarily because the predominant form of the manure has changed. Prior to ten years ago, more or less, straw or other bedding was used which absorbed part of the moisture in the manure. Not only has the form changed, but also a drastic increase in the volume of waste material to be handled in one location has occurred. The conventional method of handling manure is with the conventional manure spreader (without modification), gutter cleaners, pit scrapers and manure bucket loaders. To be successful using the conventional method, dairy manure and poultry manure must have dry matter added, whereas swine manure can be spread without added dry matter. Semi-fluid material is of most interest because most of today's large operations use this method. The solution to handling semi-fluid rests with three alternatives: (1) develop equipment to handle it in this form, (2) change to liquid by adding water, or (3) change the form to a solid. The liquid handling is gaining popularity because conventional mechanical pumping methods may be used. The ease of storing liquids is also an advantage for using this system. It enables an operator to store manure, thus reducing labor. The treatment process must be considered, however, in any of these systems to reduce odors. (Bundy-Iowa State)

### 0663-B1, C2, D1, D2, D3, E2, F2, F4

**INTEGRATION OF COMPONENTS INTO A SYSTEM,**
Cornell Univ., Ithaca, N.Y. Dept. of Poultry Science.
R. J. Young.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management February 10-12, 1971, Syracuse, New York, p 142-149. 7 fig.

Descriptors: *Farm wastes, *Water quality act, Landfills, Farm lagoons, Incineration, Treatment, Oxidation lagoons, Regulations, Fertilizers, Nutrients, *Standards, *Institutional constraints.
Identifiers: *Air quality standards, Land spreading, Composting, Local regulations, State regulations.

In analyzing the various methods for handling animal wastes, each method must be considered with the individual management application in mind. It is also apparent that there are a number of constraints and alternatives which must be taken into consideration before a given system is adopted. These constraints are the local, state and federal regulations in regard to air and water quality standards, public health laws and environmental protection regulations. The long-range consequences of any action taken must be evaluated so that the solution of one waste disposal problem does not create another. High priority should be given to the incorporation of animal wastes into a cropping system to get the maximum uptake of nutrients. If possible, recycling and reuse of animal wastes should be part of the management system. The primary consideration is to be given to source control. Examination of all of the feasible methods that meet the conditions of state and federal regulations may show that the cost of waste disposal for a particular product is far too costly, and therefore a more economical procedure may be a change in management practice which would prevent or significantly reduce the amount of waste materials generated. (Bundy-Iowa State)

### 0664-A11, A12, E1, F2, F3

**ADVISORY GROUPS FOR ENVIRONMENTAL PROTECTION AND AGRICULTURAL COOPERATION,**
Wisconsin Univ., Madison. Dept of Dairy Science.
J. W. Crowley.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York, p 150-156.

Descriptors: *Farm waste, Regulations, Waste disposal, Cattle, Public health, Safety, Legal aspects.

The idea of an advisory group can be illustrated by experiences with advisory groups in other general problems. In dairy production, the involvement of various production groups, marketing groups, and quality control agencies has a long history. There have been occasions when one group formulated ideas without due consideration of the needs or responsibilities of the other group. Also, there have been many questions or problems that require immediate practical solutions but only judgment or guesses are available. When this occurs, the best judgment or guess results when all groups involved discuss, debate, and finally compromise on the practical solution. The primary objective of the advisory committee is to develop guidelines. These must be acceptable to all groups that have enforcement responsibilities. The suggestions in the guidelines must also be practical and realistic; however, they cannot assure compliance with regulations. The advisory committee is essentially an Ad Hoc group; however, permanent structure is needed so that a representative can request and get action for revision. The guidelines are essentially an educational publication and should be continually up-dated as needs arise. (Bundy-Iowa State)

### 0665-A6, B2, B4, D3, E2

**WASTE MANAGEMENT ON A MODERN DIARY FARM,**
R. Everingham.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York, p 157-160.

Descriptors: *Farm waste, *Cattle, Confinement pens, Soil disposal fields, Septic tanks, Odors, Liquid wastes, New York, Waste treatment.
Identifiers: *Dairy wastes, Liquid-manure spreader, Pit agitation, *Syracuse (N.Y.).

A New York dairy farmer gives an account of his 100-cow free-stall liquid-manure-handling system. The system is located within a 15-minute drive to downtown Syracuse, which makes him very aware of the odor problems that a dairy operation might cause. The liquid manure tank was designed on the specifications of 1-1/2 cubic feet per animal per day with enough capacity for two months. At the time the pit was built, it was decided that a two-month clean-out period would be sufficient, but after operating the system for awhile, it was recognized that a four-month period would be better. This would eliminate having to spread the manure during the summer months or the cold winter months on frozen ground. Also, the specifications of 1-1/2 cubic feet per animal per day should be increased to 2. The equipment used to remove the manure consists of an agitator pump and a 1400-gallon liquid-manure spreader. In his operation, the spreading, especially in the summer, is the most critical part of the operation. The operator at this point feels the system is workable. (Bundy-Iowa State)

### 0666-A4, D1, D2, D3, E2

**PERFORMANCE OF DUCK WASTEWATER TREATMENT FACILITIES,**
New York State Veterinary Coll., Eastport. Duck Disease Research Lab.
K. J. Johanson.
In: Agricultural Wastes: Principles and Guidelines for Practical Solution, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York, p 161-166. 3 fig, 3 ref.

Descriptors: *Farm waste, *Poultry, Oxidation lagoons, Settling basins, Waste water disposal, *Waste treatment, Chlorine, Run-off, *Treatment facilities.
Identifiers: *Pre-settling lagoon, Confined buildings, *Duck wastes.

The Long Island duck industry is presently comprised of 35 farms and processing plants, marketing approximately 7 million ducks a year. This figure represents about 65% of the nation's ducks with the majority going to New York restaurants

and markets. A minimum of 6 gal. of water per duck per day is necessary. Most farmers use between 10 and 20 gal. of water per duck per day. In the past, ducks were given free access to the freshwater streams and rivers and their wastes were carried out into the waterway, which caused serious pollution. In order to curb this pollution, the New York State Department of Health required duck farmers to comply with a four-phase program of water pollution abatement. The first two phases of this program called for the removal of ducks from open waters and providing facilities that would remove settleable solids. The third phase of the order called for the disinfection of the waste effluent. The fourth phase called for nutrient removal. Each farm involved in waste treatment is issued an operating permit after the system has been inspected and approved by the New York State Dept. of Environmental Conservation. The permit describes the approved facilities and specifies what equipment is incorporated into the system, such as the size, number and capacity of aeration lagoons, settling lagoons, chlorination tanks, pumps, and the number of aerators to be utilized. These facilities cannot be altered without prior approval of the New York State Department of Environmental Conservation.
(Bundy-Iowa State)

### 0667-A2, B2, B3, D3, E2

**FOOD PROCESSING WASTEWATER TREATMENT,**
Harnish and Lookup, Assoc., Newark, N.Y.
P. Russell.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York, p 167-172. 3 fig, 2 tab, 14 ref.

Descriptors: *Waste water treatment, Irrigation, Lagoons, Activated sludge, Aeration, Water management, New York.
Identifiers: *Food processing, Wastes, Spray irrigation.

In the food processing sector of the agricultural industry, wastewater treatment and disposal is one of the most significant problems facing today's corporate management. In New York state alone, over 100 food processing plants produce wastewater equivalent to 5 million people. The problem must be completely determined in order to provide a proper wastewater management program. An in-plant wastewater sampling program is essential to determine wastewater sources and characteristics. A process flow schematic is also essential. To treat the wastewater, preliminary treatment includes screening, nutrient additions, pH control, and equalization in many cases. In some cases, spray irrigation is a very suitable means for wastewater disposal from food processing operations. The important elements of a spray irrigation system are adequate surface area and a soil which allows for infiltration into the ground. In other instances where a BOD removal efficiency up to 85% is adequate, aerated lagoons have been employed successfully in treating food processing wastewaters. Methods including stabilization ponds, filter, and chemical treatment are used when advanced treatment is necessary.
(Bundy-Iowa State)

### 0668-B2, C2, D1, D2, D3, E3, E4, F5

**PHOTOSYNTHETIC RECLAMATION OF AGRICULTURAL SOLID AND LIQUID WASTES–SECOND PROGRESS REPORT,**
California Univ., Berkeley. Sanitary Engineering Research Lab.
Gordon L. Dugan, Clarence G. Golueke, William J. Oswald, and Charles E. Rixford.
California University, Sanitary Engineering Research Laboratory, Report No. 70-1, 165 p, 24 fig, 55 tab, 51 ref. US Public Health Service 5RO1 UI 00566-03.

Descriptors: *Farm wastes, *Poultry, Waste water treatment, Sedimentation, Oxidation lagoons, Anaerobic digestion, Algae, Sludge, Methane, Organic loading, Hydrogen ion concentration, Temperature, Centrifugation, Coagulation, Dewatering, *Cost analysis.
Identifiers: Volatile solids, Grit.

A 36-week study was initiated to provide information on the economics of treating animal wastes. Chickens were chosen, mainly for convenience sake, as the waste producers to be studied, and 113-twenty week old leghorn pullets were placed in cages. The treatment system used consisted of inclined troughs under the cages which were flushed with water from a flushing bucket, grit removal, sedimentation, an oxidation lagoon for the sedimentation tank supernatant, and an anaerobic digester for the solids. The systems approach was used, and system balances were performed for total solids, volatile solids, total unoxidized nitrogen and energy for the chickens, sedimentation tank, digester, and algae. All balances were performed from week 5 through week 36 except for the digester, where operation was terminated at week 24 and the solids dewatered, dried, and studied for possible further reuse. An economic analysis of an integrated system of 100,000 laying hens revealed a cost of approximately 2 cents/dozen eggs for a system based on the one tested. However, consideration of an extremely conservative algae harvesting rate of 12 tons/acre/year at a price of 5 cents/lb (dry weight) dropped the overall waste handling outlay to approximately 1 cent/dozen. On this basis, additional studies were recommended to aid in the implementation of treatment facilities for animal wastes as soon as possible. (Lowry-Texas)

### 0669-A2, A4, A6, B2, B3, B4, C1, C2, C3, D2, D3, E2, E3

**ANIMAL AND HUMAN METABOLIC WASTES.**
Illinois Univ., Urbana. Council on Environmental Quality.

Proceedings of First Allerton Conference, December, 1970, Special publication no. 21, College of Agriculture, Illinois University at Urbana-Champaign, April, 1971, p 23-25. 2 tab.

Descriptors: *Farm wastes, *Water pollution, *Biochemical oxygen demand, *Sludge disposal, Municipal wastes, Anaerobic digestion, Oxidation, Fertilizers.
Identifiers: Pollution abatement, Population equivalents.

Livestock needed to produce America's meat supply also produce 2 billion tons of manure per year. Undiluted livestock wastes are 100 times more concentrated than municipal sewage. Pollutants include plant nutrients, oxygen-demanding components, infectious agents, color, and odor. Aerobic bacteria thrive at Dissolved Oxygen levels down to .5 ppm, but fish need about 4 ppm. Typical BOD livestock population equivalents include dairy cow — 12, 200 pound hog — 2.5, and laying hens — 0.10. The greatest potential for stream pollution is feedlot runoff. Methods of abatement include diverting rainwater around lots, collecting runoff in detention ponds, and putting roofs over lots. Most odor nuisance can be avoided by incinerating, composting, refeeding proteinaceoussolids, or anaerobically digesting. Farmland can be used to dispose of digested sludge of municipal waste treatment plants. Typical fertilizer contents of total sludge (water and solids) are 5 per cent nitrogen, 3 per cent phosphorus, and .5 per cent potassium. Land, not watercourses, should be the receptor of livestock and municipal waste residues. (Schmitt-Iowa State)

### 0670-A3, A5, A6, A7, B2, B3, D2, D3, E2

**ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES,**
Cornell Univ., Ithaca, N.Y. Dept. of Civil and Agricultural Engineering.
Raymond C. Loehr.
Journal Water Pollution Control Federation, Vol 43, No 4, p 668-678, 2 fig, 2 tab, 10 ref.

Descriptors: *Farm wastes, *Disposal, *Treatment, *Systems analysis, Runoff, Pollutant, Nutrients, Aerobic treatment, Anaerobic digestion, Dentrification, Nitrification, Effluents, Legal aspects, Waste water treatment, Waste disposal.
Identifiers: Options, Land disposal, Oxidation ditch, Pollutional characteristics alternatives.

The various systems for treating wastes from enclosed confined animal production operations are discussed. There is no one process or waste management system that will be adequate for all animal production operations. Aeration systems such as oxidation ditches are gaining acceptance for waste handling and treatment. It is unlikely that current liquid waste treatment systems for treating concentrated animal waste water will produce effluents that can be discharged to surface water. Land disposal is an integral part of feasible animal waste treatment systems. (Christenbury-Iowa State)

### 0671-A6, A7, B3, B5, C2, D1, D2, F6

**REMOVAL OF WATER FROM ANIMAL MANURES, PART II: EFFECTS OF VELOCITY ON AIR DRYING,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
In: Agricultural Waste Management and Associated Odor Control, Cornell University AWM 71-04, September 1, 1971. 10 p, 2 tab, 7 fig, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Drying, Waste storage, Odor.
Identifiers: Air-drying manure.

Water can be removed from animal manures by mechanical, thermal, and absorptive means. Thermal removal was investigated by utilizing a thin layer of unheated air, and a very low or 'static' air velocity. The equilibrium moisture content of chicken manure is comparable with other agricultural hygroscopic materials. Effects of humidity on drying time are significant but sample variation has an effect similar to a plus or minus 15% relative humidity change. Temperature, configuration of manure, thickness, compaction, velocity of air, and the biological state of the manure also affects the drying rate. Exposure to drying on both sides had an effect on 1/4 in. thick manure samples for velocities less than 700 FPM, but the effect was insignificant for 1/8 in. samples. Velocities greater than 800 FPM did not appreciably reduce the drying time from that of the 800 FPM level. Drying times for velocities 800 FPM or greater were approximately 1/3 that for 'static' conditions. The time required to remove the last 0.9 percent of water was approximately 8 hours at 'static' conditions and 5 hours at the higher velocities.
(Schmitt-Iowa State)

### 0672-A6, B3, B5, C1, D1, D2

**MEASUREMENT OF MANURE GASES BY GAS CHROMOTOGRAPHY,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. L. Day.
In: Agricultural Waste Management and Associated Odor Control, Cornell University, AWM 71-04, September 1, 1971. 6 p, 1 fig.

Descriptors: *Farm wastes, *Gas chromatography, *Ammonia, *Carbon dioxide, Methane, *Hydrogen sulfide.

Identifiers: Varian Aerograph Model 200 Chromatograph, Porapak T, Porapak S, Porapak Q, Porapak R, Carle T.C. detector.

A combination of gas chromatograph equipment was sought to measure manure gases, specifically ammonia. Previous work had used both thermal conductivity and hydrogen flame detectors for measuring methane, hydrogen sulfide, and carbon dioxide. A setup using silica gel and molecular sieve columns in series was considered undesirable since the molecular sieve is suspected of permanently retaining CO2, NH3, and H2O. Experiments were conducted with a Varian Aerograph Model 200 Chromatograph with T.C. detector with a 1/8 in. X 8 ft. of 100-120 Porapak T column and a Carle T.C. detector with 1/8 in. X 8 ft. of 30-80 mesh Porapak Q in series with 1/8 in. X 8 ft. of 50-80 mesh Porapak R. Ultimately it was found that there was as much CO2 in a cylinder marked as 123 ppm NH3 and the balance N2 as in a CO2 cylinder marked as 0.49% CO2, 20.8 O2, and balance N2. This explained the identical elution time for the NH3 and CO2 cylinders. 123 ppm NH3 was below the detection level for the gas chromatograph setups. NH3 in the absence of CO2 was used in other tests. The thermal conductivity and hydrogen flame detector chromatographs were not very reliable for quantitative measurement of ammonia in the 2,000 to 12,000 ppm concentration range; the threshold level appears to be 1% or higher. (Schmitt-Iowa State)

### 0673-A6, D1, F6

**OLFACTORY MEASUREMENT OF ANIMAL MANURE ODOR,**

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
In: Agricultural Waste Management and Associated Odor Control, Cornell University, AWM 71-04, September 1, 1971. 21 p, 12 fig, 7 tab, 11 ref.

Descriptors: *Farm wastes, *Poultry, *Drying, *Odor.
Identifiers: Air-drying manure.

The gas chromatograph can detect compounds to 10-12g of any material, but odornus compounds below this level can be readily detected by the human nose. Consequently, an odor panel was created and asked to rate various manure samples as to the presence of odor, and the offensiveness of the odor. A scale of 0-10 was used with zero representing no odor and 10 representing a very strong and offensive odor. Samples included manure that was undiluted, diluted in various proportions, and manure that was dried to various moisture contents. The use of a rating method utilizing the human nose for odor evaluation provides valuable information for comparing manure handling and treatment systems. Ratings for odor presence and odor offensiveness are very similar. Descriptive terms help in catagorizing odors. Olfactory observation along with visual observation produces a different rating in comparison with olfactory observation only. Visual observation may introduce some bias. Since there is no right answer to an olfactory test, the test must be set up and run under conditions such that the results can be used for comparison only. (Schmitt-Iowa State)

### 0674-A6, A7, B2, B3, D1, D2

**CONTROL OF ODORS THROUGH MANURE MANAGEMENT,**

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
D. C. Ludington, A. T. Sobel, and B. Gormel.
In: Agricultural Waste Management and Associated Odor Control, Cornell University, AWM 71-04, September 1, 1971. 17 p, 13 fig, 8 tab, 2 ref.

Descriptors: *Farm wastes, *Poultry, *Drying, *Odor.
Identifiers: Air-drying manure.

Attempts to mask, counteract, or oxidize odors from manure have been largely unsuccessful. If odors cannot be controlled once they have been formed, an effort must be made to inhibit the production of odors. To evaluate the success of efforts to control odors a measuring device is needed. A panel of humans rating odor presence and offensiveness from 1 to 10 has been found the best device for evaluation. Experiments were conducted to check the influence of moisture removal and manure removal on the odor offensiveness of the gases released from chicken manure. Removing moisture reduced the odor level. Diluted manure always produced the highest offensiveness and undiluted manure the next highest. Daily scraping which did not allow buildup of manure was also a successful technique for controlling odor. A manure management system which either removes the manure from the building at least daily without manure buildup or removes moisture from the manure will cause a minimum amount of air pollution. (Schmitt-Iowa State)

### 0675-A6, B3, C1, D1

**UNDER CAGE DRYING OF POULTRY MANURE,**

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
B. Gormel, A. T. Sobel, and D. C. Ludington.
In: Agricultural Waste Management and Associated Odor Control, Cornell University, AWM 71-04, September 1, 1971. 15 p, 7 fig, 7 tab.

Descriptors: *Farm wastes, *Poultry, *Drying, Waste disposal, Odor.
Identifiers: Air-drying manure.

Various means to achieve drying of poultry droppings before they could mat together into a solid mass were investigated. Fins made of different materials placed at various angles, screens, and rotating pins were investigated, with air movement at 3 to 4 cfm per bird. The moisture content of manure from caged layers was reduced to 50% by use of metal fins below the cages. Fins at more than 45 deg. angles caught a low percentage of the manure and thus, had small effect. Supplementary fins at 30 deg. beneath the 45 deg. fins were not self-emptying. Air circulation is of great importance in fin drying of poultry manure. Vertical fins will hold about 46% of the total manure when the fins are placed 3/4 in. apart. Half-inch expanded metal allowed too high a percentage of fresh droppings to pass into the pit to be a significant benefit in the drying process. Rotating pins reduced the moisture content to about 50% but something stronger than the 1/4 in. maple dowel 7 3/4 in. pins is needed. In these tests, drying took place partially on the devices such as screens, metal fins or spindles with significant additional drying of the crumbled manure occurring in the chamber pits because the devices prevented the formation of a solid mass of droppings in the pit. (Schmitt-Iowa State)

### 0676-A2, A5, A6, B5, C2, C3

**CHEMICAL AND MICROBIAL STUDIES OF WASTES FROM BEEF CATTLE FEEDLOTS,**

Agricultural Research Service, Lincoln, Nebr. Soil and Water Conservation Research Div.
T. M. McCalla, and F. G. Viets, Jr.
Proceedings: Pollution Research Symposium, May 23, 1969. Typescript, 24 p, 14 tab, 77 ref.

Descriptors: *Microorganisms, Chemical properties, Cattle, Farm wastes, Odor, Runoff, Confinement pens.
Identifiers: Great Plains, Nebraska, Feedlot.

Chemical and microbial characteristics of beef cattle waste are discussed along with some of the possible microbial and chemical transformations that reduce the disposal problem. The cattle feedlot waste depends on the ration feed. Generally, cattle in feedlots are started on a high-roughage ration and quickly shifted to a high-concentrate one. A high-concentrate ration has about 75% to 85% digestible material and 5% to 7% minerals, resulting in 4 to 5 lbs. of feces per animal per day. Pollution of groundwater beneath beef cattle feedlots appears to be determined by a number of factors; namely, stocking rate, manure removal, depth of water table, and soil texture and structure. Indications are that low stocking rates and frequent manure removal contribute to nitrate leaching into the water table. Also, feedlots in which the groundwater is relatively close to the surface are more apt to contain nitrate in excess of 10 ppm than are feedlots with a deeper water table. Beef cattle feedlots established on coarse-textured, sandy soils may permit more movement of pollutants to the groundwater than those established on fine-textured clay soils. (Dorland-Iowa State)

### 0677-A2, B2, B3, D3, E2, F1, F3

**THE POLLUTION POTENTIAL OF THE CONFINED LIVESTOCK FEEDING INDUSTRY**

Midwest Research Institute, Kansas City, Missouri.
The Pollution Potential of the Confined Livestock Feeding Industry, Final Report, Midwest Research Instiuite, 425 Volker Bolevard, Kansas City, Missouri, November, 1971. pp. 1-224.

Descriptors: *Farm Wastes, Biochemical Oxygen Demand, Cattle, Feedlots, Waste Treatment, Economic, Runoff, Aerobic Treatment, Sheep, Swine, Poultry.
Identifiers; Manure Handling Techniques.

The confined livestock feeding industry has been studied in depth. Typical feedlot operations have been examined, livestock wastes have been characterized, and waste management techniques and treatment processes have been evaluated. Animal wastes are highly concentrated. Conventional treatment processes can be applied to these wastes, but will not produce effluents suitable for stream discharge. Such treatment, therefore, is seldom feasible and rarely necessary if good management practices are followed. Animal waste management is aimed at returning the wastes to the land, with essentially no effluent reaching natural waterways. Appropriate management practices include: 1) minimizing the quantity of runoff by diversion of all water outside the feedlot; 2) Controlling runoff emanating from inside the feedlot; 3) detaining liquid runoff fro mthe feedlot in ponds or lagoons; 4) returning the detained liquids to the lands as required to prevent detention pond overflow; and 5) periodically removing solid wastes from feedlots for ultimate disposal on land. Such practices will be compatible with the industry's economic structure, acceptable to the industry's management, and effective in eliminating known pollution hazards. Auditional research is needed to insure that the synthetic chemicals used in livestock feeding operations are not harmful when returned to the environment. (Bundy-ISU)

### 0678-A4, A5, A6, B1

**THE FUTURE OF FARM ANIMAL WASTE MANAGEMENT,**

Minnesota Univ., Minneapolis. Dept. of Agricultural Engineering.
James A. Moore, and Donald B. Brooker.
Agricultural Engineering, Vol 51, No 7, p 414, 417, July 1970.

Descriptors: *Farm waste, *Water treatment, *Water pollution control, *Long term planning, Manure, Odor, Agricultural engineering.

Predicts the future development of livestock waste management schemes. It includes a discussion of future water quality requirements as well as the necessity for odor control. The need for mechanization as well as increased energy consumption are discussed. (Miner-Iowa State)

### 0679-A7

**NITROGEN LOSSES FROM ALKALINE WATER IMPOUNDMENTS,**

San Diego State Coll., Calif. Dept. of Civil Engineering.
Frank E. Stratton.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 95, No SA2, p 223-231, 1969. 5 fig, 1 tab, 3 ref.

Descriptors: *Alkaline water, *Nitrification, *Nitrogen, Impoundments, Ammonia, Analysis, Analytical techniques, Hydrogen ion concentration, Temperature, Winds, Effluents, Lakes, Surface waters, California.
Identifiers: Elfin Forest Lake (Calif), Gaseous ammonia nitrogen, Degasification.

A method of estimating the loss of gaseous ammonia from alkaline waters consists of analysis of samples from outdoor impounded water subject to mixing by wind. Another method involves the use of a floating cell and acid trap to determine ammonia liberated from an impoundment. The field tests were conducted from June to September in two small California eutrophic impoundments: Elfin Forest Lake with pH 9.5-9.8, and a pH 9.1 effluent pond at the Santee Water Reclamation. The measured rate of loss of ammonia nitrogen for the Elfin Forest Lake was 3.3 milligrams per square foot/day, whereas that for the Santee pond, 9.1 milligrams per square foot/day. The determined values constituted 14% and 22% of the predicted values for these basins, respectively. (Wilde-Wisconsin)

### 0680-E1, E2, E3, F1

**ECONOMIES OF RECOVERY AND DISTRIBUTION OF ANIMAL WASTE,**

California Univ., Davis.
W. J. Clawson.
Journal of Animal Science, Vol. 32, No. 4, April 1971, p 816-820, 1 tab, 9 ref.

Descriptors: *Farm wastes, Economics, Cropland, California, Waste management, *Waste disposal, *Waste treatment, *Feed lots.

No one method will satisfy the need for suitable waste management in animal agriculture. Two basic pathways seem to be available for disposal of animal waste. The first is utilization of all or parts of the animal waste where a cost is incurred and a value for the product (s) is returned. The alternative may be outright destruction or degradation of animal waste where a cost is incurred and no return is evident. Acknowledgment must be made of the fact that agriculture will be forced to stop pollution and that the additional cost of this type of waste management may not be recovered from waste alone. Future research must help provide more methods of cleaning and transporting animal wastes. Another approach is to study methods which will permit the effective growth and fattening of animals in less confined areas than is currently the case. By treating the removal and distribution of animal wastes as an expense to the animal production industry, evaluation of waste disposal methods is improved and a more intelligent evaluation of alternative methods may be made by the animal industry. (Bundy-Iowa State)

### 0681-A2, A8, C2

**EFFECT OF FEEDLOT LAGOON WATER ON SOME PHYSICAL AND CHEMICAL PROPERTIES OF SOILS,**

Kansas State Univ., Manhattan. Dept. of Agronomy, and Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
David O. Travis, W. L. Powers, L. S. Murphy, and R. I. Lipper.
Partially supported by OWRR, Dept. of Interior.
Soil Science Society of America Proceedings. Vol 35, No 1, p 122-126, January-February 1971. 5 p, 7 fig, 4 tab, 12 ref. OWRR Project A-016-KAN (2).

Descriptors: *Farm wastes, *Water pollution effects, *Path of pollutants, *Irrigation water, *Waste water disposal, Lagoons, Saline soils, Nitrates, Salts, Leaching, Soil water, Soil chemistry, Soil properties, Soil texture, Soil structure.
Identifiers: Feedlot lagoons.

Lagoon water from cattle feedlot runoff was added to undisturbed soil columns 42 cm long and 6.7 cm in diameter. The infiltration rate of the lagoon water into the columns was measured and recorded. After each run, the soil columns were sectioned into 3-cm increments and analyzed for Ca, Mg, Na, K, and NH4 ions. Also the electrical conductivity of a saturation extract from the top 15 cm of each column was determined. Water flow in the soil columns stopped for all soils before two pore volumes of filtrate could be collected. The percentages of Na, K, and NH4 ions increased in the surface increments of the soil columns. The electrical conductivity of the saturation extracts for all soils was increased by more than 200% by adding the lagoon water to the soil. The saturation extract of the treated soils had electrical conductivity values of between 2.80 and 5.05 mmhos/cm. (Knapp-USGS)

### 0682-A6, B2, B4, C2, D1, D3

**AERATION OF LIQUID POULTRY MANURE; A STABILIZATION PROCESS OR AN ODOUR CONTROL MEASURE,**

Guelph Univ. (Ontario). Dept. of Microbiology.
R. G. Bell.
Poultry Science, Vol. 50, No. 1, January 1971. p 155-158. 3 fig, 9 ref.

Descriptors: *Farm wastes, Biochemical oxygen demand, *Odor, *Aeration, *Poultry, Anaerobic digestion, *Degradation (Decomposition), Liquid wastes, *Waste water treatment.
Identifiers: Fatty-acids.

The offensive odors associated with the storage of liquid manures are caused by the accumulation of the by-products of the anaerobic decomposition of fecal organic matter. A direct relationship has been observed between the concentration of one such group of by-products, the volatile fatty acids, and the odor quality of stored liquid poultry manure. It was suggested that a 0.1% fatty acid content was an acceptable level for new facilities and 0.2% was a minimum level for the initiation of prosecutions under any proposed air pollution legislation. Aeration, on purely theoretical grounds, must be a means of preventing stored liquid manure from acquiring a foul odor since anaerobiosis and the presence of free oxygen are incompatible. In practice it is now well established that aeration is an effective way by which to control the odor of liquid manure. The present study was undertaken to ascertain whether the fatty acid content remained a reliable odor assessment criteria for aerated stored manure; and to observe whether an aeration rate sufficient to control odor would result in the stabilization of the manure. The fatty acid content was shown to provide a reliable assessment of the odor quality of stored aerated liquid poultry manure. For satisfactory odor control in the manure storage system containing 0.562 cu. ft. of water per hen it was only necessary to satisfy 37% of the daily applied BOD. Aeration as used in the experimental system must be considered as an odor control measure and not as a stabilization process. (Bundy-Iowa State)

### 0683-A6, A7, A11, A12, B2, C2, D1, D3, E2

**ANIMAL WASTE HANDLING AND DISPOSAL IN CONFINEMENT PRODUCTION OF SWINE,**

Purdue University, Lafayette, Ind. Dept. of Animal Science.
J. H. Conrad, and V. B. Mayrose.
Journal of Animal Science, Vol. 32, No. 4, April 1971. p 811-815. 22 ref.

Descriptors: *Farm wastes, *Confinement pens, *Swine, *Odors, Farm management, Irrigation, Biochemical oxygen demand, *Aeration, *Waste water treatment.
Identifiers: Slotted floors.

Farmer-producers are becoming larger and more specialized. An estimated twenty-five percent of the hogs are produced in total confinement and another fifty percent of the hogs produced by large producers are in partial confinement during the growing and/or finishing period. As confinement feeding increases, concern about the volume of wastes excreted does also. Some procedures of measuring and facts about fecal production are discussed. An ideal manure handling system should incorporate the ultimate in automation, oxidize volatile solids, require a minimum amount of maintenance and be economical to operate. Waste disposal systems discussed include; mechanical or hand scraping and cleaning in conjunction with total hauling and spreading, a combination of scraping and flushing the wastes into a lagoon or holding pit, a slotted floor over a pit, a slotted floor over a pit with oxidation wheel, slotted floor over a lagoon, slotted floors over a pit with oxidation wheels and a lagoon, and the plow-furrow-cover technique. Another problem with swine confinement is gas generation. Some of the gases generated are toxic while others cause offensive odors. Speculation into the future has come up with this system, perhaps with slight modifications, as an acceptable one. Animals will be reared in totally enclosed buildings on slotted floors. Wastes will be flushed by recycled lagoon water into the lagoon which contains a floating aerator. Effluent containing both liquid and suspended fine solids will be used for crop irrigation. (Bundy-Iowa State)

### 0684-A2, A6, C2, F4

**CHANGING PRACTICES IN AGRICULTURE AND THEIR EFFECT ON THE ENVIRONMENT,**

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering; and California Univ., Davis. Dept. of Agricultural Engineering.
Raymond C. Loehr, and Samuel A. Hart.
CRC Critical Reviews in Environmental Control, Vol 1, No 1, p 69-99, February 1970. 31 p, 7 fig, 9 tab, 67 ref.

Descriptors: *Reviews, *Bibliographies, *Water pollution sources, *Farm wastes, Waste treatment, Aesthetics, Odors, Sewage disposal, Disposal, Farm management, Water pollution control, Environment, Water quality, Air pollution, Urbanization.
Identifiers: Animal production wastes.

This review emphasizes one facet of agriculture, animal production as an example of the changes that have taken place in agriculture. The major topic areas include: productivity increases, changes in size of operations, handling problems, waste characteristics, surface and groundwater quality, land application of wastes, land runoff, odor production, and waste management techniques. Because farms are located in relative isolation surrounded by apparently unlimited land, air, and water, contaminants generated by agriculture usually would be sufficiently dilute or stabilized before potential problems become real. Modern developments in agriculture and growing recreational use of rural lands are tending to eliminate this relative isolation. The large livestock producer is in the animal rather than in the crop-farming business. He relies on commercially available feeds for a considerable portion if not all of his feeding requirements, has a minimum interest in utilization of the resultant manure in crop production, and may not have adequate land of his own for satisfactory disposal of the animal wastes. The outlook is for continuation of these trends in modern agriculture and for an increase in the environmental problems described in this review. No new facility or expansion of existing facilities for agricultural production should be considered without prior planning which should include the probable environmental effects of the disposal of wastes from the facility. (Knapp-USGS)

### 0685-A6, A7, A11, A12, B2 B4, C2, D1, D2

**GASES AND ODORS FROM STORED SWINE WASTES,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Journal of Animal Science, Vol 30, No 4, p 526-531, April 1970. 18 ref.

Descriptors: *Farm wastes, Ammonia, Manure, *Gases, Odor, Methane, Carbon dioxide, Hydrogen sulfide, *Hogs.
Identifiers: Swine confinement, *Manure odors, Storage pits.

One major problem arising from the storage, handling, treating and eventual utilization or disposal of hog wastes associated with confinement hog systems is the inevitable presence of gases and odors. The most important gases generated in a hog confinement unit are thought to be carbon dioxide, ammonia, hydrogen sulfide, methane and a large group of trace compounds such as amines, mercaptans, and skatoles. Under normal conditions in an adequately ventilated confinement unit no noxious gas reaches lethal or even harmful concentrations for pits or humans. Critically dangerous conditions exist when the oxygen content of the air diminishes from the normal 21 to 10% or less. It is only under special conditions such as during a ventilation failure, or during rigorous agitation of the manure pit that dangerous levels are reached. It may be possible to apply the industrial methods of treating odors; namely, dilution, absorption, adsorption, masking, counteraction and burning to the control or odors from stored manure. (Miner-Iowa State)

### 0686-A11, B2, B3, D1, D2, E3, F1

**NEW PROCESS CONVERTS CATTLE RUMEN TO FEEDSTUFF,**
D. Natz.
Feedstuffs, Vol 43, No 28, July 10, 1971. 1 fig.

Descriptors: *Farm wastes, Cattle, Suspended solids, *Waste treatment, *Feeds.
Identifiers: Feeding trials.

A practical means of turning rumen content (paunch) of slaughtered cattle into a valuable feed ingredient is claimed by Dr. Paul A. Stahler, a Minnesota medical doctor. The patented 'Stahler Conversion Process' actually converts the paunch material into two usable feed ingredients. One is a concentrated liquid fed to hogs as a top dressing over grain. The other is a dehydrated product which is fed to cattle much like silage. Stahler's process first separates the liquids and solids by suction, then compresses the high moisture solids to extract more liquid. The liquids then go into a holding for sterilization and processing. The solids move into a revolving drum-type heating and drying unit where they are exposed to 2000 to 3000F temperatures. The solids can then be pelleted if desired. Stahler reported that the paunch, when processed according to the prescribed methods, will provide a minimum of 75% of the commonly accepted nutritive requirements of beef cattle during the finishing phase. He said that it has even more potential as a pre-finishing ration - from about 400 to 800 pounds. The cost to produce this material in 1960 was about $17.04 per ton. During feeding trials conducted by Stahler, cattle gained an average of 2.5 pounds per day on a ration of which a major part was paunch products. Stahler predicted that beef production nationally could be increased by 25% by utilizing the rumen content of animals as a feed product. (Wallin-Iowa State)

### 0687-B2,C1,C2,D3,F1

**OPERATION OF AN ANAEROBIC POND ON HOG ABATTOIR WASTEWATER,**
Steeg (Henry B.) and Associates, Inc., Indianapolis, Ind.; and Wastewater Treatment Plant, Logansport, Ind.
C. F. Niles, and H. P. Gordon.
In: Proceedings, Industrial Waste Conference, 25th, May 5-7, 1970, Purdue University, Engineering Extension Series No. 137, Part II, p 612-616, I tab.

Descriptors: *Waste water treatment, *Operating costs, Anaerobic conditions, Effluents, Activated sludge, Biochemical oxygen demand, Labor, Pretreatment, Management, Indiana, *Lagoons, *Industrial wastes.
Identifiers: *Abattoir wastewater, Anaerobic lagoons, Secondary treatment, Suspended solids.

The development of a design for an anaerobic pond for pretreatment of the wastewater from an abattoir, design criteria and details of the anaerobic pond, and the operating techniques being used in treating the effluent from the anaerobic pond before discharge to the river are described. Some information on operating results, labor requirements and power consumption are also included. It was estimated that processing 400 hogs per hour on a one shift kill would result in a flow of 800,000 gal per day with a peak rate of 1400 gal per min. It was further estimated that this wastewater would contain 8000 pounds of BOD and 6650 pounds of suspended solids per day. The effluent from the lagoon was introduced into the activated sludge secondary treatment step of the city sewage treatment plant. For successful operation on a year-round basis, a cover for the lagoon was considered necessary. The cover was composed of straw and grease and maintained temperatures year-round above 80 degrees F. (Dorland-Iowa State)

### 0688-B5, C1, C2

**CHARACTERIZATION OF WASTE TREATMENT PROPERTIES OF PIG MANURE,**
Newcastle-upon-Tyne Univ. (England). Dept. of Agricultural Engineering.
J. R. O'Callaghan, V. A. Dodd, P. A. J. O'Donoghue, and K. A. Pollock.
Journal Agriculture Engineering Research, Vol 16, No 4, p 399-419, December 1971. 13 fig, 15 tab, 8 ref.

Descriptors: *Farm wastes, *Hogs, Feeds, Biochemical oxygen demand, Chemical oxygen demand, Solid wastes, Hydrogen ion concentration, Nutrients, Phosphorus, Potassium, Confinement pens.
Identifiers: *Total solids, Volatile solids.

The daily faecal and urinary production from individual pigs were measured over the live-weight range 20-90 kg. Three different feeding regimes were employed. Faecal and urinary production can be expressed as a percentage of meal and water consumed; the values are influenced by feeding regime. The results from the study on individual pigs were, in general, confirmed by a trial carried out on groups of pigs. There was no significant difference in the quantity of manure produced by hogs and gilts. Feeding regime was found to influence significantly the major properties of pig manure. The properties studied included biochemical oxygen demand, chemical oxygen demand, total solids, volatile solids, pH and the major nutrient elements, nitrogen, phosphorus and potassium. No significant reduction in either oxygen demand or volatile solids was achieved by storing the manure in dung channels for periods of up to 18 weeks. (Bundy-Iowa State)

### 0689-A2, A4, A5, A7, B1, F2

**WASTE MANAGEMENT FOR FEEDLOTS,**
Nebraska Univ., Lincoln. Coll. of Agriculture.
E. A. Olson.
Extension Service Bulletin, E.C. 71-795, (1971). 14 p, 15 fig.

Descriptors: *Farm wastes, *Nebraska, Livestock, Runoff, *Feed lots, *Water pollution control, *Pollution abatement, Legal aspects.

Guidance and information are provided to help livestock producers develop facilities that will, by proper waste management, help prevent pollution. Careful selection of a new site for livestock production facilities can help reduce potential water and/or air pollution problems. Methods for controlling and managing waste runoff for existing or new lots are described. These techniques are based on results of recent research on waste management by USDA Agricultural Research Service personnel and the University of Nebraska. The Nebraska Water Pollution Control Act requires that programs to control livestock wastes be operational by December 13, 1972. (Bundy-Iowa State)

### 0690-A11, B1, F6

**AN IMPROVED METHOD FOR SEPARATE COLLECTION OF URINE, FECES, AND EXPIRATORY GASES FROM THE MATURE CHICKEN,**
Agricultural Research Service, Fargo, N. Dak. Metabolism and Radiation Research Lab.
G. D. Paulson.
Poultry Science, Vol 48, No 4, p 1331-1336, 1969. 3 fig, 7 ref.

Descriptors: *Farm wastes, *Urine, *Poultry, Sampling, Carbon dioxide.
Identifiers: Surgical modification, Poultry urine collection, Metabolism cage.

An improved method for surgical modification of the chicken and collection apparatus to facilitate separate collection of urine and feces is described. There was no mortality from surgery, and the modified birds were normal, as evaluated by outward appearance, feed and water consumption, urine and feces excretion, and post examination of sacrificed birds. A metabolism unit and a system for collecting respiratory CO2 from the chicken are also described. (Miner-Iowa State)

### 0691-B1, B5, C1

**THE EFFECT OF HUMIDITY AND FLOORING TYPE ON THE MOISTURE CONTENT OF BROILER EXCREMENTS,**
West Virginia Univ., Morgantown. Dept. of Animal Industries and Veterinary Science.
R. A. Peterson, M. A. Hellickson, W. D. Wagner, and A. D. Longhouse.
Poultry Science, Vol 49, No 2, p 439-443, March 1970. 1 fig, 2 tab, 2 ref.

Descriptors: *Farm wastes, Livestock, *Poultry, *Manure, Humidity, Air environment.
Identifiers: Broilers, Moisture content, *Flooring systems.

Experiments were conducted in part to determine the effect of humidity and flooring type on the moisture content of excreta from broilers. The experiments using broiler type chicks fed a high energy ration were conducted in four controlled 1.8 x 2.4 x 2.4 m environmental chambers. Relative humidity was measured and maintained. The following types were used, (1) 2.5 cm by 2.5 cm. welded wire (2) 1.3 cm. by 2.5 cm. welded wire and (3) 1.9 cm. flat wooden slats spaced 0.6 cm. apart. The average moisture content was significantly less in excreta collected under 1.9 cm. flat slats than collected beneath either 2.5 x 2.5 cm. or 1.3 x 2.5 welded wire floors. (Miner-Iowa State University)

## 0692-A11, C2, C3

**EFFECT OF FEED PROCESSING ON DIGESTIBILITY OF ANIMAL FEEDS,**
Kansas State Univ., Manhattan.
H. B. Pfost.
(1970) 21 p, 22 tab, 20 ref.

Descriptors: *Farm wastes, Feeds, Feed lots, Cattle, Microorganisms, Ammonia, Hogs.
Identifiers: *Daily gain, Daily feed, Starch.

Some degree of starch gelatinization improves the feed efficiency for beef, swine and broiler feeding enough to be economically feasible under typical conditions in the United States. The utilization of urea in ruminant rations can be improved by use in combination with gelatinized starch. The results of using a highly gelatinized product for feeding swine appear interesting from a research standpoint and may prove to be practical later. Much of the past research which involved grain processing is difficult to interpret because of the failure to measure and report chemical and physical changes which occurred during processing. Standardized methods which are correlated with animal performance need to be developed. Protein availability must be considered as well as starch availability. Future developments in equipment for processing must consider the economic costs required to obtain desired levels or product change. (Bundy-Iowa State)

## 0693-C2

**IDENTIFICATION AND EXCRETION OF ESTROGEN IN URINE DURING THE ESTROUS CYCLE OF THE EWE,**
Purdue Univ., Lafayette, Ind. Dept. of Animal Sciences.
E. D. Plotka, and R. E. Erb.
Journal of Animal Science, Vol 29, No 6, p 934-939, 1969. 2 fig, 1 tab, 27 ref.

Descriptors: Farm wastes, *Sheep, *Urine, Organic compounds, *Chromatography.
Identifiers: Estrone, *Estrogen, Pregnant ewes.

Estrone was identified in urine of the non-pregnant ewe by comparing its behavior to crystalline standard estrone and by its failure to separate from added 14C-estrone through solvent partitioning, paper chromatography, successive thin-layer chromatography in different systems, gas-chromotography, (GLC) on three columns, derivative formation and chromatography of the derivatives. The highest average rate of excretion of estrone and estradiol occurred during estrus averaging 394 and 479 ug./24 hr. as compared to the lowest rates of 20 and 17 ug./hr., respectively, the second day after estrus. Expressing excretion rate as ng/mg. of urinary creatine was highly correlated (r-0.97-0.98) to total excretion based on total collection of urine for 24 hours. (Miner-Iowa State)

## 0694-B2, B4, D3, E2

**MANAGEMENT PRINCIPLES APPLICATION TO THE DISPOSAL OF CATTLE MANURE TO PREVENT POLLUTION,**
Washington State Univ., Pullman. Coll. of Engineering Research Div.
D. E. Proctor.
Paper presented at the Eighth Texas Industrial Water and Wastewater Conference, Lubbock, Texas, June 6, 1968. 13 p, 1 fig.

Descriptors: *Farm wastes, Dairy industry, *Waste disposal, Confinement pens, Runoff, *Washington, Aerobic treatment, Lagoons.
Identifiers: Anaerobic lagoons, *Monroe (Wash).

The Sanitary Engineering Section of the College of Engineering Research Division was asked to consider the manure problem at a dairy and milk processing plant near Monroe, Washington. Winter flooding and cost were two problems that influenced the systems set up for the 230 to 240 cows. The final system consisted of scraping and flushing the manure into a central slurry sump. From here the manure can either be pumped to the fields for disposal through a manure 'gun' or pumped to one of three storage lagoons. Each lagoon measures 115 feet by 115 feet by 18 feet and all three can hold about 430,000 cubic feet of material. (Wallin-Iowa State)

## 0695-B1

**CONTROL OF POULTRY HOUSE VENTILATION SYSTEMS USING SOLID-STATE CONTROLS,**
Agricultural Research Service, State College, Miss. Farm Electrification Research Branch.
F. N. Reece, and J. W. Deaton.
Transactions of the American Society of Agricultural Engineers, Vol. 14, No. 6, p 1073-1075, November-December, 1971, 3 fig, 2 tab, 7 ref.

Descriptors: *Confinement pens, *Ventilation, *Poultry, Temperature, Cooling, *Waste treatment.
Identifiers: *Solid-state controls, Humidity controller, Variable-speed d-c motor.

Chickens, because of size, growth characteristics and sensitivity to light, lend readily to manipulation of production efficiency through confinement housing. However, as with any livestock, the success of confinement housing is dependent largely on the ventilation system. The conventional poultry-house ventilation system generally uses multiple fans, usually low-pressure axial-flow type, controlled by time clocks and thermostats, to regulate ventilation rate and control house temperature and humidity. The application of solid-state voltage control devices, used to control the speed of permanent split-capacitor, fractional-horsepower motors, further refines the system by providing resolution of the incremental steps of the multiple-fan system. The application of variable-speed, 1-hp and larger, d-c, electric motors with solid-state control to poultry-house ventilation systems appears to offer a method of solving some of the current problems in ventilation systems. By using a variable-speed, d-c motor and an appropriate, solid-state power controller regulated manually in summer and by means of dry-bulb or dew-point temperature transducers in winter, ventilation rate can be controlled in windowless poultry houses over the entire range necessary for optimum conditions throughout the year. The system provides a method of reducing the complexity of design and operation of ventilation systems. (Bundy-Iowa State)

## 0696-A4, A5, B2, C2, C3, E1, E2

**QUALITY OF EFFLUENT FROM SWINE PRODUCTION AREAS,**
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering; and North Carolina Water Resources Research Inst., Raleigh.
J. W. D. Robbins, G. J. Kriz, and D. H. Howells.
Paper No. 69-706 presented at 1969 Winter meeting of the American Society of Agricultural Engineers Chicago, Illinois, December 9-12, 1969. 42 p, 21 fig, 4 tab, 21 ref. FWPCA Grant 13020 DGX.

Descriptors: *Farm wastes, Water quality control, *Surface waters, Discharge, Lagoons, Hogs, *Nitrates phosphorus, Coliforms, Biochemical oxygen demand, Chemical oxygen demand, *Toxicity, Antibiotics, Water pollution sources.
Identifiers: *Effluent disposal, Land application, Direct discharge, Automatic sampler, Feed additives.

Results are presented of the swine waste phase of a study initiated to identify the amounts of and factors governing pollutional loadings reaching surface waters and to answer whether and under what conditions animal wastes are a significant source of stream pollution. Knowledge of these factors is necessary to develop meaningful waste control, treatment, and disposal requirements for surface water protection. Results from representative swine waste management systems of lagooning, land disposal, and direct discharge to stream demonstrated the superiority of land disposal in controlling stream pollution. Discharge of lagoon effluents or direct discharge into surface water is unacceptable from a water quality standpoint. In land disposal, care must be taken that good management practices of soil and water conservation are followed to minimize movement of wastes into streams. The amount of wastes applied per unit area should be low enough to prevent excess nitrate levels in groundwater. Toxic substances in the wastes are a cause of difficulties in BOD tests on lagoon wastes. (Dorland-Iowa State)

## 0697-A3, A4, B2, B3, C2, C3, E1, E2

**ROLE OF ANIMAL WASTES IN AGRICULTURAL LAND RUNOFF.**
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering
Environmental Protection Agency, Water Pollution Control Research Series, August 1971. 114 p, 32 fig, 19 tab, 75 ref, 2 append. EPA Program 13020 DGX 08/71.

Descriptors: *Farm wastes, *Runoff, *Agricultural runoff, *Water pollution, *Farm lagoons, Waste disposal, Sampling, Analysis, Disposal.

Twelve typical agricultural areas representing three types of animal waste management techniques--lagooning, direct discharge into streams, and land spreading including pasture and drylot units--were studied to determine the amounts of and factors governing stream pollution from swine, dairy, beef, and poultry production operations. More than 1500 stream and lagoon effluent samples were collected with an automatic sampler developed for the study. The samples were analyzed for bacteria, nutrients, and degradable organics. Hydrological and waste management data were also collected. Study results point to the superiority of land spreading for the disposal of animal wastes. Good soil and water conservation practices should be used to minimize the movement of wastes into streams. Higher rates of runoff result in heavier pollution. The location of disposal areas away from streams is important in controlling the amount of entering wastes. Even when land disposal areas are poorly located, the amount of pollution entering streams is usually low; and watershed factors, such as surface culture and ease of erosion, are of primary importance in governing the magnitude of pollution which reaches the streams. Direct dumping of animal wastes, treated or untreated, into streams is completely unacceptable and should be prohibited. (Dorland-Iowa State)

## 0698-A2, A4, A11, B2, C2, D1, E1

**CHARACTERISTICS AND EFFECTS OF CATTLE FEEDLOT RUNOFF,**
Robert S. Kerr Water Research Center, Ada, Okla.
M. R. Scalf, W. R. Duffer, and R. D. Kreis.
In: Proceedings, Industrial Waste Conference, 25th, May 5, 6, and 7, 1970. Purdue University, Engineering Extension Series No. 137, Part 2, p 855-864, 10 fig, 3 tab, 6 ref.

Descriptors: *Farm wastes, *Runoff, *Fishkill, Cattle, Dissolved oxygen, Diversion structures, Sedimentation, Biochemical oxygen demand, Algae, Confinement pens, Impoundments, *Water pollution sources, *Agricultural runoff, *Water pollution effects, *Cattle, *Feed lots.
Identifiers: Algal blooms.

Cattle feedlot capacity in the United States has been increasing at about 10 percent annually in recent years. Essentially, all this growth has been in the form of large scale feedlots of 5000 to 100,000 head capacity. As with the concentrations of people, the concentration of thousands of animals in a small area produces massive environmental problems. Rainfall runoff may contain pollutant concentrations 10 to 100 times those of raw municipal sewage, and uncontrolled access to streams can result in oxygen depletion, fish kills, and other long term, undesirable ecological conditions for miles downstream. This study was designed to measure the quantity of rainfall runoff and its pollutional characteristics from a commercial feedlot and evaluate the effect of this wastewater on small impoundments. Less than two weeks of sedimentation in runoff collection ponds produced on effluent with pollutant concentrations of 10 to 30 per cent of the mean direct runoff concentrations. The necessity of further treatment was demonstrated when the feedlot operator pumped collection pond effluent through an inadequate treatment system into a 45-acre flood control reservoir. Essentially, all game fish in the reservoir were killed due to dissolved oxygen stress and high ammonia concentrations. (Dorland-Iowa State)

### 0700-A2, A4, B2, C2, D1, D3

**LIVESTOCK WASTE DISPOSAL AND WATER POLLUTION CONTROL,**
Colorado State Univ., Fort Collins. Cooperative Extension Service.
R. W. Hansen.
Colorado State University, Cooperative Extension Service, Bulletin 480a, October 1971. 13 p, 4 fig, 2 tab, 6 ref, append.

Descriptors: *Farm wastes, Feed lots, Cattle, Runoff, Odor, Lagoons, Settling basins, Nitrogen, Phosphorus, Potassium, Colorado, Waste disposal, Waste water treatment, *Water pollution control.
Identifiers: Controlled runoff, Anaerobic lagoons.

The purpose is to acquaint the feedlot operator and the livestock man with the general requirements for the control of pollution from livestock facilities. Both federal and state agencies are active in developing and implementing controls to enhance environmental quality. These efforts obviously and logically include livestock enterprises. General information is provided on types of systems that may be used to prevent pollution from feedlot runoff. The design of the system should be done by competent engineers. Engineering services are available from the Soil Conservation Service and consulting engineering firms. (Bundy-Iowa State)

### 0701-A3, A5, C3, D3, E2

**WATER POLLUTION AND AGRICULTURE,**
Kansas State Department of Health, Topeka. Environmental Health Services.
M. W. Gray.
(1968), 14 p, 2 tab.

Descriptors: *Farm wastes, Feed lots, Runoff, Kansas, Rainfall, Biochemical oxygen demand, Bacteria, Coliform, Streptococcus, Fishkill, Cattle, Lagoons, Irrigation.

Natural runoff pollution is defined as pollution resulting from all salts and organic materials carried by watercourses not originating from municipal, industrial, or agricultural operations. Agricultural pollution is pollution as a result of surface runoff, seepage, percolation and return flow from cultivated land used for producing food and feed crops. Animal feedlot pollution is pollutants originating from animal feeding operations of restricted area where the feed supply is nutritionally balanced for maximum animal weight gain prior to marketing. The public generally thinks first of pollution as originating from some industrial plant with black clouds of smoke pouring from its stacks and equally black foul liquids pouring from subterranean channels. The public probably will not be acquainted with pollution from agriculture except fishermen who have practiced their art in the areas of some of our highly intensified farming-livestock areas. (Bundy-Iowa State)

### 0702-A4, C3

**BUFFALO LAKE PROJECT, RANDALL COUNTY, TEXAS.**
Robert S. Kerr Water Research Center, Ada, Okla.

December 1968, 64 p, 7 fig, 10 tab, 36 ref.

Descriptors: *Farm wastes, *Runoff, Rainfall, Bacteria, Coliforms, Streptococcus, Lakes, Recreation, Water sports, *Texas.
Identifiers: *Buffalo Lake (Tex).

Buffalo Lake is a shallow, man-made reservoir of 18, 150 acre-feet capacity located on Tierra Blanca Creek, some 50 miles southwest of Amarillo, Texas. During this study the lake was only 13 feet deep at its deepest portion near the dam. At this depth the lake contained 3990 acre-feet of water and had a surface area of approximately 950 acres. The shoreline is characterized by gently sloping sandy beaches readily accessible by automobile. The overall objective of the Buffalo Lake pollution study as sponsored by the Texas Water Quality Board is to determine the cause of the recurring pollution of Buffalo Lake. The objectives include the answers to the following questions: (1) What effect do the various waste sources have on the bacteriological quality. (2) What is the fate of the three indicator groups of bacteria entering the lake. (3) What effect does the extensive water contact recreational use of Buffalo Lake have on the total coliform, fecal coliform and fecal streptococci densities. (4) What are the densities of coliforms in and around the lake before and after rainfall. (5) Does the bottom mud in the lake contain any appreciable densities of the three bacterial indicators. (6) Do any appreciable concentrations of pesticides exist in the lake. (7) What corrective measures should be taken to control the bacterial pollution of Buffalo Lake and its tributaries. It was recommended that the city of Hereford should properly chlorinate its treated sewage effluent on a continuous basis to protect the bacteriological quality of Tierra Blanca Creet; and that any portion of Buffalo Lake which becomes contaminated by bacterial density of over 200 fecal coliforms per 100 ml should be posted to water contact recreation. (Bundy-Iowa State)

### 0703-A2, A7, A8, C1, C2, C3

**FEEDLOT WASTE MANAGEMENT: SOME SOLUTIONS TO THE PROBLEM,**
Agricultural Research Service, Lincoln, Neb.
N. P. Swanson, and C. B. Gilbertson.
Paper presented at the 1971 annual meeting, American Society of Agricultural Engineers, Washington State University, June 27-30, 1971, Paper No. 71-522. 6 p, 9 ref.

Descriptors: *Farm wastes, *Feed lots, Moisture content, Sampling, Runoff, Settling, Basins, Weirs, Analytical techniques.
Identifiers: Bedloads.

Feedlot waste management has come under increased scrutiny for the related reasons of waste disposal problems and pollution potential. Measurement of these wastes is necessary to determine their chemical and physical content, to determine rates of waste accretion and degradation, and to assess the transport of wastes by runoff. Characterization of feedlot wastes required quantitative measurement of manure accumulations on the feedlot surface, runoff from rainfall and snowmelt, movement into the soil profile, and the air quality surrounding the feedlot. The measurement and sampling of runoff from feedlots must include solid contents and bedloads. Some satisfactory methods of measurement include volumetric measurement, Parshall flume, and weirs; methods found unsuitable include the trapezoidal flume and Hs - and H - type measuring flumes. Time-sequential, rotating dipper, proportional samplers are satisfactory for obtaining representative samples of feedlot runoff. Ideally, a runoff hydrograph should be accompanied by a sequence of representative samples of the runoff and bedload, each sample taken over a uniform time interval. (Bundy-Iowa State)

### 0704-A6, B1, E1, F1, F2

**PLANNING ANIMAL WASTE DISPOSAL SYSTEMS,**
Oregon State Univ., Corvallis. Cooperative Extension Service.
W. E. Matson.
Oregon State University, Extension Circular 736, May 1971. 15 p, 15 fig, 4 tab.

Descriptors: Farm wastes, Regulation, Economics, Government agencies, Costs, Waste disposal, Legal aspects, Odor.

Problems of animal waste disposal will continue to be important factors in determining the location of large scale livestock enterprises. The producers and the public must realize animal waste handling, treatment, and disposal will cost something. No one treatment process or treatment system will be the solution for all animal production units. Sanitary engineers, agricultural engineers, economists, agronomists, animal husbandry people, and others will need to closely coordinate activities. Research and demonstration projects are badly needed. Many of the most obvious cases of pollution could have been prevented if the facilities were located in different areas. The economics of pollution and nuisance control in animal production may mean the difference between success and failure for the facility. Livestock operators are urged to keep informed of current regulatory policies of the Department of Environmental Quality. The Cooperative Extension Service can be helpful in planning expansion or dealing with waste disposal problems. (Bundy-Iowa State)

### 0705-A11, F6

**A MATHEMATICAL SIMULATION OF BEEF ANIMALS–A REALITY WITH POTENTIAL,**
Oklahoma State Univ., Stillwater.
M. D. Paine, J. A. Witz, A. F. Butchbaker, J. E. McCroskey, and C. M. Bacon.
Paper presented at the 1971 Fall Meeting, Oklahoma Section, American Society of Agricultural Engineers Stillwater, November 5, 1971. 21 p, 7 fig, 3 tab, 9 ref.

Descriptors: *Mathematical models, *Cattle, *Environmental effects, *Computer models, Computer programs, Simulation analysis, Model studies, Numerical analysis, Data processing, Energy transfer, Metabolism, Theoretical analysis, Optimization, Feed lots, Nutrient requirements, Energy.
Identifiers: Thermal activity, Energy balance.

The development of beef feedlots with one time capacities of 30,000 head and more has created a need for better mathematical estimates of the effects of climate and nutrition upon beef production. This greater production places greater demands up0n management and encourages the use of systems modeling techniques to develop a better mathematical model of a beef animal than existed. This model would allow data from feeding trials to be applied to another location in a different environment. The basic conceptual model is represneted by a combination of three energy reservoirs with energy flow between the reservoirs. These reservoirs represent digestion, metabolism, and thermal activity. The model can then simulate growth responses to energy intake and environmental factors. The model can thus be used to calibrate optimum values of the parameters used in a simulation and thus show the most economical feed ration or any other such factor. The model should prove, after further calibration, useful in feedlot situations. The present model and optimization routines can now be used to predict results of management decisions. (Dorland-Iowa State)

## 0706-A6, B2, B4, E2, F1

**HANDLING, STORAGE, AND TREATMENT OF DAIRY AND BEEF CATTLE WASTES IN CONFINED SYSTEMS,**
**Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.**
**J. A. Moore, and D. W. Bates.**
**Paper No. 69-935, presented at the 1969 Winter Meeting of the American Society of Agricultural Engineers at Chicago, Illinois. 9 p, 6 fig, 8 ref.**

**Descriptors: *Farm wastes, *Storage tanks, *Disposal, Cattle, Treatment facilities, Confinement pens, Labor, Structural design, Slurries, Storage, Waste disposal, Waste treatment, Waste water treatment.**
**Identifiers: *Mechanization, *Land spreading, Gutter cleaners, Bedding, Slatted floors.**

**Increasingly complex systems for manure management of livestock operations have been developed. This complexity is mainly due to pressure from environmental concerns and the need to reduce labor requirements in these operations. The development of manure handling systems in dairy operations is reviewed. These systems range from hand labor systems to the more modern gutter cleaner where the system was completely mechanized to reduce labor to a minimum with a corresponding increase in capital investments. These systems are all based on the liberal use of bedding to absorb the liquid from the wastes. The use of bedding involves the cost of obtaining the bedding and keeping it in place. Producers have begun to try to reduce these costs by reducing the use of bedding. Recently there has been an increase in the use of storage tanks under the floor and the use of slatted or partly slatted floors. If there was little or no bedding in the manure it would spread itself in and out of the building storage tank, eliminating the need for a mechanical distribution system. The need to reduce odors and solids will bring about more efficient treatment systems in the future. (Dorland-Iowa State)**

## 0707-A7, D2

**A METHOD FOR THE TREATMENT OF ANIMAL WASTES TO CONTROL AMMONIA AND OTHER ODORS,**
Vineland Labs., Inc., N.J. Research Div.
William Seltzer, Stanley G. Moum, and Tevis M. Goldhaft.
Poultry Science, Vol 48, No 6, p 1912-1918, November 1969. 4 tab, 10 ref.

Descriptors: *Odor, *Ammonia, *Farm wastes, Air pollution, Poultry, Hogs, Cattle, Bactericides.
Identifiers: Paraformaldehyde, Methogen, Odor control, *Manure odors.

Discusses the use of flaked paraformaldehyde for direct treatment of animal wastes to prevent or eliminate the noxious gases from animal quarters. Paraformaldehyde is a mixture of polyoxymethylene glycols containing 90-99% polymerized formaldehyde. Paraformaldehyde liberates formaldehyde gas as it decomposes. For many years ammonia gas has been used to neutralize formaldehyde gas. This work is predicated on using the principal in reverse. The action of the flake paraformaldehyde on the animal wastes was concluded to be both chemical and antimicrobial and these combined actions make it of value in the control of noxious odors and gases emanating as a result of bacterial fermentation. (Miner-Iowa State)

## 0708-A2, B2, C1, C2, C3, F6

**TOTAL ORGANIC CARBON DETERMINATIONS ON SWINE WASTE EFFLUENTS,**
**North Carolina State Univ., Raleigh.**
**J. W. D. Robbins, G. J. Kriz, and D. H. Howells.**
**Paper presented at the 1969 Winter Meeting American Society of Agricultural Engineering, Chicago, Illinois, December 9-12, 1969. Paper No. 69-928. 26 p, 9 fig, 19 ref.**

**Descriptors: *Farm wastes, *Biochemical oxygen demand, Hogs, Runoff, Lagoons, Confinement pens, Hydrogen ion concentration, Nitrates, Ammonia, Bacteria, Chemical oxygen demand, *Analytical techniques.**
**Identifiers: *Total Organic Carbon, Fresh manure.**

**Total organic carbon measurements (using a Beckman 915TOC analyzer) were made on swine waste effluents to establish a rapid and accurate auxiliary method to substitute for and/or complement the BOD test for determining degradable organic contents and/or oxygen demand loadings. The standard BOD test has very limited value for characterizing fresh swine waste and swine waste lagoon effluents although it has considerable applicability for more dilute swine wastes in land drainage. Toxic substances, high solids contents, and/or the requirements for high dilutions in analyses are major factors in this regard. The TOC analysis provides a convenient, rapid, and dependable method for determining the amount and strength of wastes entering streams through land runoff from swine growing operations. While the TOC can be useful in characterizing raw swine waste effluents, its utility for this purpose is presently limited by difficulties common to the standard BOD analysis. If a satisfactory relationship with oxygen demand could be developed, the TOC test would be a better pollution parameter than BOD. Conjunctive use of BOD and TOC parameters can be useful in characterizing swine wastes and wastewaters, particularly when toxic materials and other factors limit the BOD test. The degree of BOD/TOC variability is one indication of wastewater consistency and the possible presence of toxic materials. Also, the BOD/TOC ratio is an indication of the ease of biodegradation and/or the degree of stabilization. (Bundy-Iowa State)**

## 0709-A2, A4, E1, F2

**BEEF CATTLE FEEDLOT WASTE MANAGEMENT PROGRAM,**
Robert S. Kerr Water Research Center, Ada, Okla.
J. L. Witherow, and M. R. Scalf.
Mimeo, April 1971, 2 fig, 1 tab, 11 ref. EPA Program 13040---04/71.

Descriptors: *Farm wastes, *Water pollution sources, *Regulation, Cattle, Kansas, Texas, Oklahoma, Feed lots, Livestock, Confinement pens.

The Environmental Protection Agency's beef cattle feedlot waste research has an objective to develop technically and economically feasible systems to abate the pollutional effects of confined beef production. Surveys show that the number of 1,000 head feedlots and the total number of cattle on feed are increasing while the number of small feedlots is decreasing. This change is in conjunction with a shift of feedlots from the midwest corn belt to the high plains area and the Southwest. A breakdown by states is given for the number of cattle on feed and the size of feedlots. Pollutional damages from large feedlots are cited. Implementing waste management systems in Kansas, Texas, and Oklahoma is by recent laws and specific regulation adopted by agencies of these states. The design requirements are described. Lack of understanding by the feedlot operator and the number of enforcement personnel are major obstacles in implementation. Pollution control and labor cost may result in total environmentally controlled cattle feedlots becoming common during this decade. (EPA abstract)

## 0710-A2, A3, A4, B1, C2, F1

**FARM ANIMAL WASTE DISPOSAL,**
**Ontario Water Resources Commission, Toronto. Div. of Research.**
**S. A. Black.**
**Water Management in Ontario Research. Publication No. 28, December 1967, 36 p, 1 fig, 9 tab, 44 ref.**

**Descriptors: *Farm wastes, *Confinement pens, Feed lots, Runoff, Nitrogen, Biochemical oxygen demand, Chemical oxygen demand, Fertilizer, Economics.**

**The theories and implications involved with the processing, treatment and disposal of farm animal wastes are described. Farm animal wastes have been contributing polluting materials to waterways for many years. The changing nature of farming in the very recent years, however, has increased considerably the pollution potential of farm animal wastes. Since this change is still in process, an intensive study into improving the methods and facilities for the disposal of farm animal wastes is well justified, as the methods of disposal available to the farmer may well control the location and magnitude of his enterprise in the future. (Bundy-Iowa State)**

## 0711-A5, A12, C2, F2

**THE NITRATE HAZARD IN WELL WATER, WITH SPECIAL REFERENCE TO HOLT COUNTY, NEBRASKA,**
**Geological Survey, Lincoln, Nebr.**
**R. A. Engberg.**
**Nebraska Water Survey. Paper 21, University of Nebraska, Conservation and Survey Division, Lincoln, October 1967. 18 p, 6 fig, 15 ref.**

**Descriptors: *Farm wastes, Feed lots, Nitrates, Wells, Well data, Well regulations, Percolating water, Pumping, Cattle, Water pollution sources, Water pollution.**
**Identifiers: *Infant feeding.**

**High nitrate concentrations in drinking water are a potential health hazard and should be of concern to the user. They not only render the water unsafe for use in infant feeding but generally indicate that the supply is contaminated. Reports of high-nitrate water from several wells in northern Holt County prompted the Lincoln, Nebraska, office of the U.S. Geological Survey to look into the problem -- to determine its seriousness, define causes, and suggest ways to cope with it. To augment the analytical information already on file, water samples were obtained from 71 wells for determination of the nitrate concentration. Concentrations ranging from 0.1 to 409 ppm (parts per million) were found. In order to predict whether a certain well is likely to yield water containing nitrate derived from a nearby source, the rate the well will be pumped and the direction of groundwater movement need to be known. The greater the rate of pumping, the greater the area from which the pumped water will be derived. A well inside or very close to a feedlot is likely to yield high-nitrate water whether the rate of pumping is small or large, whereas a well more distant from the feedlot may need to be pumped heavily for the high-nitrate water to be drawn into it. (Bundy-Iowa State)**

## 0712-C2

**CATTLE FEEDLOT WASTE CHARACTERISTICS,**
Colorado State University, Fort Collins, Colorado Graduate Student.
E. M. Jex.
Cattle Feedlot Waste Characteristics, Master of Science Thesis, Colorado State University, Fort Collins, Colorado, January 1969, pp. 1-70, 17 fig, 13 tab.

Descriptors: *Farm Wastes, *Feed Lots, Cattle, Biochemical Oxygen Demand, Hydrogen Ion Concentration.

This study was undertaken to investigate the aqueous characteristics of cattle feedlot wastes. There were two areas of investigation: 1) Biochemical oxygen demand (BOD) characteristics; 2) Conductivity, oxidation-reduction potential, pH, dissolved solids, volatile solids, coagulation and foaming characteristics. The data and results reported here represent laboratory analysis of feedlot manure samples (combined urine and feces sample from feedlot pens) diluted with distilled water to varying degrees. A modification of the classical first stage BOD equation was developed which allows calculation of total BOD versus curves which closely approximate the experimental data. Equations were derived from the van't Hoff-Arrhenius relationship permit calculation of the BOD rate constant k and the ultimate combined demand L at any temperature. (Bundy - ISU).

## 0713-C1, C2, D3

**SOME AEROBIC DECOMPOSITION PROPERTIES OF DAIRY-CATTLE MANURE,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
A. C. Dale, and D. L. Day.
Transactions of the American Society of Agricultural Engineers, Vol. 10, No. 4, p 546-548, 1967, 11 fig, 6 tab.

Descriptors: *Aerobic treatment, *Farm wastes, Biochemical oxygen demand, Cattle, Nitrogen, Phosphorus, Potassium, *Waste water treatment.
Identifiers: *Oxidation ditch, Volatile solids.

Additional information on aerobic decomposition properties of dairy-cattle manure would be helpful in designing Pasveer ditch dairy-production units. Information is needed on such characteristics as (a) percent of the volatile solids that can be broken down into carbon dioxide and water, (b) percent of solids that will be left in the ditch, and (c) BOD of the effluent. An experiment was conducted with the above factors in mind. The following conclusions were drawn: (a) the greater the concentration of dairy cattle wastes added to an aerobic digestion chamber, the lower the breakdown of the volatile solids; (b) approximately 50 percent of the volatile solids will be decomposed in a retention time of 18-1/2 weeks when the daily added wastes amount to 1/2 percent of the volume. (Manure contained 12.5 percent dry matter.) (c) Approximately 46 percent of the volatile solids will be decomposed in a retention time of 18-1/2 weeks when dairy cattle wastes are added at a rate of 1 percent of the volume of the aeration chamber daily. (d) The effluent, as indicated by the 5-day BOD, of all systems was reduced by more than 90 percent. (e) Salts are concentrated to some extent, but they did not appear to retard bacterial action for the concentrations obtained. (Bundy-Iowa State)

## 0714-C3

**EVALUATION OF CULTURE MEDIA FOR THE ISOLATION OF SALMONELLAE FROM FECES,**
Iowa State Univ., Ames. Dept. of Veterinary Microbiology and Preventative Medicine.
R. M. Sharma, and R. A. Packer.
Journal of Applied Microbiology, Vol 18, No 4, p 589-595, 1969. 6 tab, 25 ref.

Descriptors: *Salmonella, *Farm wastes, *Cultures, Cattle, Hogs, *Isolation.
Identifiers: Brilliant Green MacConkey Broth, Tetrathionate Broth, Selenite Broth.

A study conducted on 300 fecal samples from a cow and a pig, each artificially contaminated with approximately four Salmonella organisms revealed that, of the three enrichment broths used in conjunction with the three selective media, the maximum number of isolations were obtained with Brilliant Green MacConkey broth (BGMB), followed by those obtained with tetrathionate (TTB), and the least with selenite broth. The combination of BGMB with Brilliant Green neutral red-lactose agar (BGNRLA), and TTB with desoxycholate citrate agar (DCA) gave an equal number of isolations. Of the three selective media used in conjunction with the three enrichment broths, the maximum number of recoveries were obtained on BGNRLA, followed by those on DCA, and least number of isolations on bismuth sulfite agar (BSA). The combination of selenite F broth-BSA appeared to be somewhat inhibitory for the growth of Salmonella organisms. Of the two selective media combinations, the DCA-BGNRLA combination yielded the highest number of isolations. The use of all three selective media gave still better results. (Miner-Iowa State)

## 0715-A4, A5, A6, D1, D3

**OVERALL PROBLEMS AND AN APPROACH TO DISPOSAL OF ANIMAL WASTE,**
Cornell Univ., Ithaca, N.Y. Dept. of Poultry Science.
R. J. Young.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970, p 1-5.

Descriptors: *Farm wastes, *Dehydration, Forced drying, Oxidation lagoons, Odor, Runoff, Poultry, Economics, Waste disposal.

As agricultural specialization, intensity, and productivity increased, problems of disposing of liquid, solid, and gaseous by-products greatly intensified. In addition to the conflict of interest over the environmental quality, is the mammoth problem of disposal of large amounts of solid waste which is not only extremely offensive but has the potential to pollute both surface and subsurface waters. Investigations have been conducted on disposal systems, identification and control of odors, prevention of water pollution, removal of nutrients, reutilization of animal wastes either as fertilizers or feedstuffs, and new methods of waste management which can become economically part of the total production system. As to odors, some masking agents were slightly effective, although the best control was to prevent the formation of the odor compound. The oxidation ditch as well as drying methods in treating animal wastes were also evaluated.
(Bundy-IowaState)

## 0716 - A6, D3, E3

**BIODEGRADATION OF POULTRY MANURE FROM CAGE LAYERS,**
Agricultural Research Service, Beltsville, Md. Husbandry Research Div.
C. C. Calvert, N. O. Morgan, R. D. Martin, and H. L. Eby.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970, p 6-12, 3 tab, 2 ref.

Descriptors: Farm wastes, Waste disposal, Poultry, Odor, Biodegradation, Larvae, Nitrogen, Drying, Protein, Fertilizer.
Identifiers: *Pupae meal.

An attempt has been made to degrade poultry manure to a relatively dry and odorless product, and at the same time produce some return over the cost of the investment. The work utilizes the common house fly to process and biodegrade manure from caged laying hens. Two stages of the house fly cycle – the larvae and pupae – are used. The fresh manure was seeded with house fly eggs, approximately 3 eggs/gm., and the eggs were allowed to hatch and the larvae were allowed to tunnel and aerate the manure. The process results in deodorizing a very obnoxious product, reducing its moisture content and volume, and has produced byproducts in the form of high protein pupae meal and a potentially useful fertilizer and/or soil conditioner. (Bundy-Iowa State)

## 0717 - D1, D3

**PROCESSING PLANT SANITATION AND ITS RELATIONSHIP TO WASTE MANAGEMENT,**
Cagle's, Inc., Atlanta, Ga.
J. K. Keim.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970. p 13-15.

Descriptors: *Farm wastes, Poultry, Biochemical oxygen demand, Sewers, Municipal wastes, *Food processing industry, Water pollution sources, Industrial wastes.
Identifiers: Processing plant sanitation.

In processing plant sanitation there can be no half-way measures. There is no substitute for cleanliness in a food preparation establishment. The problem has two main factors: the amount of pollutants in the effluent, and the amount of effluent itself. The blood during poultry processing creates a big problem. The two largest sources of blood are the bleeding alley and the contents of the vacuum lung tank. Some plants still have a continous stream of water running over the floor while others permit it to accumulate and then at cleaning time push it into a gutter and wash it down to the separator. The majority of the blood handled in this way also ends up in the sewer, only a minor amount being sufficiently solid to fail to escape from the separator. If the plant is connected to a city sewer, the chances are very great that the charge is based on B.O.D. load. These charges would soon pay for equipment to reduce the loading. Relatively new cleaning systems utilize high pressure and small volume and make the cleaning operation more efficient. (Bundy-Iowa State)

## 0718 - C2, C3, D1

**WATER UTILIZATION IN PROCESSING PLANTS,**
Agricultural Research Service, Athens, Ga. Animal Products Lab.
D. Hamm.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970, p 16-22, 2 tab.

Descriptors: *Farm wastes, Poultry, Biochemical oxygen demand, Bacteria, *Food processing industry, Water utilization.
Identifiers: *Poultry processing plant.

A poultry processing plant (PPP) today is a ravenous user of clean water. Water usage per bird processed more than doubled during the 8 year period from 1957 to 1965 – up from a 5 to 7 gallon average to a 12 to 15 gallon average. This means a total of 28 lbs of input or 36 lbs water per pound of edible product. Like all functioning biological systems, a PPP uses water to transport, disperse, and to regulate temperature. Parts and wastes are water flumed; water scalds the bird, washes it to disperse and transport wastes and debris; water cools it; and water cleans up the building and equipment. There are three general problem areas insofar as water in and from PPP's are concerned. The problems are: (1) how to cut down on volume; (2) how to reduce total waste loading; and (3) how to process the waste water before returning it to the environment. Research is needed to find ways to reduce the quantity required in poultry processing plants. (Bundy-Iowa State)

### 0719 - A11, E2

**FEEDING PROBLEMS ARISING FROM THE USE OF POULTRY LITTER ON PASTURES,**
GEORGIA Univ., Athens. School of Veterinary Medicine.
D. J. Williams.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970. p 23.

Descriptors: *Farm wastes, Poultry, Cattle, Fescues, Pastures, *Animal diseases, Fertilizer, Waste disposal.
Identifiers: *Fat necrosis, Dead fat.

Cattle grazing on tall fescue heavily fertilized with poultry house waste may be developing a condition which tentatively has been called 'fat necrosis' or 'dead fat,' among other things. Postmortems on cows showed portions of the abdomen area covered with this very hard, chalky fat and in some instances this fat has completely closed the small intestines and surrounded kidneys, shutting off the urine process. Empirical evidence indicates that grain supplement 4-6 weeks prior to parturition prevents the development of this condition. (Bundy-Iowa State)

### 0720-A11, C2, E2

**PROGRESS REPORT: PASTURE FERTILIZATION USING POULTRY LITTER,**
Agricultural Research Service, Watkinsville, Ga. Soil and Water Conservation Research Div.
S. R. Wilkinson, W. A. Jackson, R. N. Dawson, and D. J. Williams.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970, p 24-29, 6 ref.

Descriptors: *Farm wastes, *Waste disposal, Poultry, Litter, Fescues, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Fertility, *Animal diseases, Fertilizer.
Identifiers: Nitrate poisoning, Grass tetany.

Growing chickens and using the litter to produce extra grass and beef has been profitable. This practice has transformed the North Georgia countryside from eroded red clay to lush green grass by enhancing soil fertility, conservation, and wise land use. However, in some pastures where rates of litter applications have been high, animal health problems such as nitrate poisoning, grass tetany, and fat necrosis have appeared. The objectives were to produce under controlled and recorded conditions a tall fescue pasture heavily fertilized with broiler litter for the purpose of studying cumulative effects of high rates of broiler litter fertilization on selected soil, plant, and animal parameters in a grazing ecosystem; including the development of potential animal health problems of nitrate poisoning, grass tetany and fat necrosis. The research has not yet been completed, but the trends indicate that each ton of broiler house litter supplies about 60 lbs. of N, 30 lbs. of K, 30 lbs. of Ca, 8 lbs. of Mg, and is an important source of Zn, as well as micronutrients. The application of 14 tons of broiler house litter over a 365 day period has made some significant changes in soil chemical properties. Broiler manured fescue grass was consistently higher in total N than inorganic fertilized fescue except during the spring. (Bundy-Iowa State)

### 0721-A2, A4, A5, A6, B1 C2, E2

**HOW ENVIRONMENTAL PROBLEMS AFFECT FARM EQUIPMENT DESIGN,**
Sperry Rand Corp., New Holland, Pa.
R. M. Alverson.
Agricultural Engineering, p 20-22, January 1971. 3 fig.

Descriptors: Farm wastes, Fertilizers, Odor, Runoff, Nutrients, Equipment, *Design, *Pollution abatement, *Environmental effects, *Farm equipment, Agriculture.
Identifiers: *Spreaders, Environmental trends.

The two most prevalent environmental trends in the U.S. today are the demands for 'clean' water and 'pure' air. These trends have been precipitated by both federal and state legislation. The Water Quality Act of 1965 (Public Law 89-234) was the first major federal legislation to force states to set minimum water quality standards and it established the Federal Water Pollution Control Administration. Future design consideration will include environmental quality concepts such as noise and vibration reduction and increased aesthetics. Future machines must also meet legal requirements for environmental protection. Design engineers should consider the trends of the environmental movement in every country where their products are sold. Legal rulings, if not aesthetic values alone, may soon require that farm equipment and procedures be non-polluting. For example, spreading manure on frozen or snow-covered ground causes a potential water pollution hazard. Odor problems with manure spreading are also prevalent. When manure is spread on the land, it may become mandatory to incorporate it into the soil. Fertilizer spreaders, pesticide applicators and tillage implements also create unwanted sources of nutrients, toxic chemicals and sediment. The environmental effects of these machines must be considered in their design. (Bundy-Iowa State)

### 0722-A4, C3

**THE USE OF FLUORESCENT ANTIBODY TECHNIQUES FOR DETECTION OF STREPTOCOCCUS FAECALIS AS AN INDICATOR OF FECAL POLLUTION OF WATER,**
North Texas State Univ., Denton. Dept. of Biological Sciences; and Clemson Univ., S.C. Dept. of Biological Sciences.
R. Abshire, and R. K. Guthrie.
Water Research, Vol 5, No 11, p 1089-1097, November 1971. 5 tab, 16 ref.

Descriptors: *Testing procedures, *Sampling, *Indicators, Streptococcus, Fluorescence, Water quality, Sewage effluents, Runoff, Water pollution sources, Bacteria, Pollutant identification.
Identifiers: *Fecal pollution, Streptococcus Faecalis, *Bacterial indicators.

A slide method for use of fluorescent antibody identification of Streptococcus faecalis is described. This method permits S. faecalis of fecal origin to be distinguished from those soil and water forms which are able to reproduce in water and sewage. Reactions were specific as confirmed by biochemical tests. Non-specific cross species fluorescence was readily removed by adsorption. Results indicate that this technique provides a method which will be useful in those pollution studies which require rapid identification and quantitation of organisms indicating fecal pollution. (Dorland-Iowa State)

### 0723-A11, E3

**FEEDING VALUE OF CATTLE MANURE FOR CATTLE,**
Auburn Univ., Ala. Dept. of Animal Science.
W. Brady Anthony.
Journal of Animal Science, Vol 30, No 2, p 274-277, 1970. 6 tab, 14 ref.

Descriptors: *Farm wastes, *Manure, Cattle, Feeds, Reuse.
Identifiers: *Cattle manure, Manure feeding, Manure utilization, Feed supplement.

The objectives were to reappraise the feeding of manure-containing rations to fattening cattle and determine if cooking the manure improved it's feeding value. Rations containing wet cattle manure were readily consumed by fattening steers and these rations supported gain essentially equal to comparable cattle fed feeds without manure. Cooking or washing manure before mixing it with concentrate for feeding did not improve its feeding value. Carcass data were similar for manure-fed and other cattle. Wet manure collected daily per yearling steer was about 13.5 kg. (3.12 kg. dry matter) and about 6.6 kg. (1.52 kg. dry matter) was consumed daily. The digestibility data do not clearly indicate effective use of either manure energy or manure crude protein. However the data show that manure did not impair digestibility and actually saved concentrate dry matter used per unit of gain. This indirect evidence strongly suggests that.manure was utilized to an appreciable degree for productive purposes. Feeding manure with concentrate did not completely alleviate waste disposal problems. Only about one-half of the manure collected daily was fed. The remainder of the daily excretion had to be disposed of elsewhere. (Miner-Iowa State)

### 0724-A4, A5, A8, B2, C2, D2, E2

**GUIDELINES TO LAND REQUIREMENTS FOR DISPOSAL OF LIQUID MANURE,**
Guelph Univ. (Ontario).
L. R. Webber, T. H. Lane, and J. H. Nodwell.
In: Proceedings Eighth Industrial Water and Wastewater Conference, June 6-7, 1968, Lubback, Texas. p 20-34, 1 fig, 4 tab, 19 ref.

Descriptors: *Farm wastes, Poultry, Confinement pens, Phosphorus, Potassium, Nitrogen, Crops, Landfills, Anaerobic digestion, Crop response, Rates of application, Fertilization.
Identifiers: *Stock piling, Incineration.

An intensification in the trend to raise livestock and poultry under high-density confinement housing has created problems in the disposal of liquid manures. Research is underway to produce guidelines that will assist producers in conforming to the pollution abatement laws in Ontario. The objectives are: (1) to set forth the accessible areas that producers must have for the utilization and disposal of liquid manure without causing water, air, or soil pollution; and (2) to test and to evaluate the guidelines by field and laboratory research and make, where necessary, revisions in the guidelines. Research has indicated that frequent and heavy applications of manure have resulted in a build-up in the soil of phosphorus and potassium without causing reductions in crop yield or contributing to the pollution of water supplied. A nitrogen balance for Ontario conditions is presented to show that crops of continuous corn or grass could be expected to utilize up to 300 lb N (from manure) per acre. Application rates greater than 300 lbs N/acre could lead to a depression of crop yield and cause water contamination. (Bundy-Iowa State)

### 0725-A11, E3

**POLLUTION CONTROL IN CATTLE FEEDLOTS THROUGH USE OF MANURE AS FEED,**
Auburn Univ., Ala. Dept. of Animal Science; and Alabama Agricultural Experiment Station, Auburn.
W. B. Anthony.
In: Proceedings Eighth Industrial Water and Wastewater Conference, June 6-7, 1968, Lubback, Texas, p 59.

Descriptors: *Farm wastes, Confinement pens, Cattle, Feeds, Feed lots, Silage, Grains.
Identifiers: *Fresh manure, Wastelage.

Sanitation for cattle fed in confinement necessitates a satisfactory and economical means of disposing of manure. In initial tests, fresh manure was blended with a concentrate and fed to cattle from which it was collected. The blending ratio was 40 parts of manure and 60 parts of grain. Although the feeding of manure directly to the cattle from which it was collected proved to be not only possible but economically advantageous in terms of improved feed efficiency. Other ways of feeding cattle manure were investigated. The making and feeding of Wastelage evolved. Wastelage is made by combining feedlot manure with grass hay and storing the mixture in a silo. (Bundy-Iowa State)

### 0726-A2, A4, B2, E2, F1

**ECONOMICS OF WATER POLLUTION CONTROL FOR CATTLE FEEDLOT OPERATIONS,**
Texas Tech Univ., Lubbock. Dept. of Agricultural Economics.
T. R. Owens, and W. L. Griffin.
In: Proceedings Eighth Industrial Water and Wastewater Conference, June 6-7, 1968, Lubbock, Texas, p 82-106. 10 tab.

Descriptors: *Farm wastes, Cattle, Feed lots, Economics, Runoff, Rainfall, Design, Costs, Water pollution control.
Identifiers: *High Plains.

One approach to the problem of water pollution from feedlots involved control of runoff by establishing collection basins and subsequently pumping the pollutant to an open land disposal area. A second suggested solution was a collection basin of sufficient size to hold polluted runoff until natural evaporation emptied the system. Data from secondary sources were used to develop the relationship between inches of precipitation and resultant runoff. Subsequently, design criteria were developed for various sizes of mechanical discharge and evaporative discharge collection systems. The various design criteria were then applied to three different sizes of feedlots, a 5000 head lot, a 10,000 head lot and a 25,000 head lot. Budgets were developed for each lot and for each system size and type, and total capital and annual operating costs were computed. The studies assumed that a part of the cost of operating any particular system would be the penalty imposed for overflow on the basis of current law, this penalty ranges from a minimum of $50/day to a maximum of $1000/day. The analysis of rainfall data provided an estimate of the number of overflows expected with any size and type of system. Thus, the cost of overflow was quantified by multiplying the number of overflows by the appropriate penalty rate. Finally, minimum cost systems providing only minimum overflow protection were compared with higher cost systems providing maximum overflow protection. Cost differences between the two systems were then evaluated to determine the increase in annual operating costs associated with additional protection. (Bundy-Iowa State)

### 0727-A3, A4, C1, C2, C3

**EFFECTS OF AGRICULTURAL DISCHARGES INTO FRESH WATER LAKES,**
Orange County Pollution Control Dept., Orlando, Fla.
C. W. Sheffield, and R. T. Kaleel.
In: Proceedings, Industrial Waste Conference, 25th, May 5, 6, and 7, 1970. Purdue University Engineering Extension Series No. 137, Part 2, p 904-913, 5 fig, 4 tab, 4 ref.

Descriptors: *Drainage effects, *Denitrification, *Eutrophication, Runoff, Nutrients, Bottom sediments, Drainage water, Nitrates, Water management, Peat, Phosphates, Dikes, Canals, Nitrification, Water pollution sources.
Identifiers: *Pumping discharge, Surface leeching, Nutrient removal.

Agricultural business has increased along with demands for its products. In the United States most winter and spring vegetable crops are grown in the warmer climates of Florida, Texas, Arizona, and California. To obtain crop growth needed for maximum production, land irrigation must be practiced. In Florida most of this farming is on peat soil that was at one time lake bottoms. Land of this nature is either developed naturally or reclaimed by man through diking and canaling systems. The effects of agricultural discharges on receiving waters are discussed, including what is being discharged chemically and how it changes the chemical, physical, and biological characteristics of the receiving fresh water lakes. The effects of nutrients into a lake are difficult to ascertain due to the effects of other nutrient sources such as sewage treatment plants, bottom recycling, rainfall, runoff, and surface leeching. However, there is a definite need to reduce turbidity, nutrients, and solids concentration in pumping discharge. (Dorland-Iowa State)

### 0728-A6, B2, D3

**ODORLESS PORK PRODUCTION: FROM CONCEPTION TO MARKET,**
Smart (Paul) Hog Farm, Lawrence, Kans.; and Kansas Univ., Lawrence. Dept. of Civil Engineering.
P. Smart, and R. E. McKinney.
In: Proceedings, Industrial Waste Conference, 25th, May 5-7, 1970, Purdue University, Engineering Extension Series No. 137, Part 2, p 757-760, 4 ref.

Descriptors: *Farm wastes, *Aerobic treatment, *Waste treatment, Hogs, Aeration, Confinement pens, Activated sludge, Biochemical oxygen demand, Rotors, Odor, Anaerobic conditions.
Identifiers: *Swine confinement, Concrete slats, Mechanical breakdown, Oxidation ditch.

The world is faced with an ever-increasing population and an ever-increasing food demand. One of the most critical food demands is for high quality meat protein. It has been possible to meet the pork needs without intensified animal growing. But the future indicated that a change was needed. In the summer of 1965, a project began to take shape that was to result in a major hog growing operation which would set the pattern for a new concept in producing pork. It was proposed that a complete animal confinement system be constructed near Lawrence, Kansas, which would yield 10,000 marketable hogs per year. This confined hog system was designed to provide the optimum environment for the animals from conception to market. One thing was apparent; no one had fully solved the problem of manure disposal. Odor nuisances created by hog manure, especially during removal and spreading, required location a considerable distance from other people. Biological concepts employed in wastewater treatment systems provided the answers needed to solve the hog manure disposal problem. The system employed a system of aerobic treatment under slotted floors. (Dorland-Iowa State)

### 0729-A6, A7, B3, B4, C1, C2, D3

**DESIGN AND OPERATION OF A PILOT PLANT FOR COMPOSTING POULTRY MANURE,**
Guelph Univ. (Ontario). Dept. of Microbiology.
R. G. Bell, and J. Pos.
Transactions of the American Society of Agricultural Engineers, Vol 14, No 6, p 1020-1023, Nov-Dec 1971. 6 fig, 6 ref.

Descriptors: *Farm wastes, Odor, *Poultry, *Waste treatment, Runoff, Air pollution, *Pilot plants, Aeration, Operation, Design.
Identifiers: *Composting.

A pilot plant for composting poultry manure is described. The composting unit consisted of a closed cylinder mounted on a steel frame, fitted with an internal rotor driven by an electric motor through a power train. Air was supplied by a fractional horsepower air compressor and was introduced into the composter through three manifold lines. Poultry manure can be composted, but the real question is whether composting reduces the pollution potential from poultry waste. The compost as discharged from the pilot plant was dark brown in color, had a nitrogen content of between 1.3 and 1.5 percent (dry wt. basis), a moisture content near 50 percent and a strong smell of ammonia. The compost did heat up which was an indication that the material was not stabilized. Even after being left unattended for several months, compost piles did not develop objectionable odors nor was there evidence of appreciable runoff during heavy rain storms. From these observations, it is concluded that composting does reduce the pollution potential of poultry manure and would, therefore, be a satisfactory way to treat manure prior to prolonged storage. (Bundy-Iowa State)

### 0730-A5, C2, E3

**AGRICULTURE'S EFFECT ON NITRATE POLLUTION OF GROUNDWATER,**
Agricultural Research Service, Fort Collins, Colo.
B. A. Stewart, F. G. Viets, Jr., and G. L. Hutchinson.
Journal of Soil and Water Conservation, Vol 23, No 1, p 13-15, January-February, 1968. 1 fig, 1 tab, 8 ref.

Descriptors: *Nitrate, *Water pollution, *Fertilizers, *Soil profiles, *Groundwater, *Agriculture, *Wastes, Alfalfa, Grasslands, Feedlots.
Identifiers: Irrigated row crops, Domestic wells.

Contributions of fertilizers applied to soil and wastes from concentrated livestock feeding operations to pollution of groundwater were studied in the middle South Platte River Valley in Colorado. Amounts of nitrate moving through 129 soil profiles varied widely with land use. Average total nitrate N to a depth of 20 ft in lbs/acre was 1436 under feed-lots, 506 under irrigated row crops, 261 under dryland row crops, 90 under native grassland, and 79 under alfalfa. The average annual loss of N to groundwater under irrigated row crops was estimated at 25-30 lbs/acre. Feedlots located near homesteads had much more effect on nitrate content of water from domestic wells than did cropped land. (Skogerboe-Colorado State)

### 0731-A3, B2, B4, E2

**DISPOSING OF ANIMAL WASTES,**
Washington State Univ., Pullman.
D. O. Turner.
Crops and Soils Magazine, p 10-11, February 1971.

Descriptors: Farm wastes, Dairy industry, Lagoons, Fertilizers, Runoff, *Waste disposal, *Washington, *Waste treatment, Water reuse.
Identifiers: Urban expansion.

Handling wastes from dairy and beef operations is difficult. In Washington, a system was designed to handle the wastes from approximately 400 dairy cattle. The location was an alluvial flood plain which was subject to frequent and severe winter flooding. The wastes from the herd were scraped and flushed to a transfer pump where they could go directly to the fields or to the two winter storage lagoons, each of which have a capacity of one million gallons. Waste material from the lagoon was transported through a pipeline and applied to silage corn and ryegrass with a sprinkler. Application was limited because of a thatch from by the fiber content of the manure which allowed surface runoff. Current recommendations are that dairymen should have one acre of disposal land for every two cows. (Bundy-Iowa State)

### 0732-A1, B2, B3, C2, C3 D1, D3, E2

**CLOSED SYSTEMS FOR ANIMAL SEWAGE TREATMENT,**
Massachusetts Univ., Amherst. Water Resources Research Center.
J. T. Clayton.

Completion Report FY 72-7, 1971. 11 p, 22 ref. OWRR A-009 MASS (4).

Descriptors: *Farm wastes, *Treatment facilities, Dairy industry, *Waste treatment, Sub-surface irrigation, Tertiary treatment, Cattle, Solid wastes, Water reuse, *Waste disposal, Aerobic treatment.

Stationary sloping screens were used to remove up to 75% of the solids in diluted dairy cattle manure. Two bench-scale aerobic treatment systems were then used to treat screened effluent. Two replicate systems, one using distilled water and one using system final effluent to dilute incoming manure were used to determine the effects of renovated water reuse. BOD reductions greater than 95% and COD reductions greater than 90% were obtained in all systems. No adverse effects of water reuse were found. Phosphate level was not affected and there was no appreciable build-up of fecal coliform or fecal streptococcus. A one-cow scale modified activated sludge system was used to treat 120 pounds of manure and 66 gallons of dilution water daily for more than six months. The final effluent was disposed of by a sub-surface irrigation system. Plastic nozzles were found satisfactory to release the liquid to the soil. BOD and COD were further reduced by about 95% in the tertiary treatment system (soil). Best performance was obtained in the two treatments in which activated sludge effluent was periodically applied to the soil

### 0733-A2, B2, B3, B4, D1, D3, E2, F1

**ALTERNATIVES FOR WASTE MANAGEMENT FOR OPEN BEEF FEEDLOTS,**
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
A. F. Butchbaker, J. E. Garton, G. W. A. Mahoney, M. D. Paine, and A. Wetmore.
Paper number SWR 71-403 presented at 1971 Annual Meeting Southwest Region of the American Society of Agricultural Engineers, Sequoyah State Park, Oklahoma. April 1-2, 1971. 20 p, 3 fig, 1 tab, 16 ref. FWQA Grant 13040 FXG.

Descriptors: *Farm wastes, *Runoff, *Solid wastes, Confinement pens, Disposal, Farm lagoons, *Waste disposal, Cattle, Cost comparisons, *Waste storage, *Design criteria, Feedlots.
Identifiers: *Cattle feedlots, Runoff treatment, Mechanical removal.

During the 1960's, the number of fed cattle marketed in the United States increased from 13 million to 25 million. This increase in fed cattle produced resulted in a corresponding increase in waste production. Daily manure production of a beef animal is about 6% of his body weight. The object was to develop open beef feedlot design criteria to minimize pollution from runoff wastes and to facilitate handling of solid and liquid animal waste and to examine alternative feedlot waste disposal systems to determine minimum cost systems for effective waste disposal. Six systems of waste handling were investigated; tractor loader and dump truck, commercial loader and dump truck, tractor loader and pull spreader, commercial loader and spreader truck, rotary scraper, and an elevating scraper. Several types of runoff control systems were also investigated; solids settling and detention, solids settling and lagoon, detention and lagoon, detention pond only, broad base detention, and batch detention. The characteristics of the solid waste material and the changes it undergoes during storage in a feedlot were also studied. (Dorland-Iowa State)

### 0734-A2, A4, B2, C3, E2

**CATTLE FEEDLOT WASTE PROBLEMS,**
Kansas State Univ., Manhattan.
R. I. Lipper, J. R. Miner, and G. H. Larson.
Paper presented at Oklahoma Cattle Feeders Seminar, February 2-3, 1967, Stillwater, Oklahoma. 9 p, 5 ref.

Descriptors: *Farm wastes, *Feed lots, Runoff, *Sprinkler irrigation, Water pollution, Cattle, *Kansas, Coliforms, Water reuse.
Identifiers: *Impounding.

Cattle feedlot runoff became recognized as a problem in Kansas during the late 1950's. Incidents of septic streams and fishkills were noted immediately following rainfall in areas where no known municipal of industrial waste discharges existed, and where chances of insecticide and herbicide residues seemed remote. To study feedlot runoff, two experimental feedlots were constructed. One was entirely surfaced with concrete; the other had concrete only around feed bunks. Rather than wait for natural storms, simulated rainfall was provided through six part-circle irrigation sprinklers spaced at the periphery of the lots. The first method for control of runoff to be studied involves impounding the runoff water until it can infiltrate adjacent land without producing further runoff. New animal research facilities are being planned at Kansas State University. Funds are being sought to incorporate research systems for processing total waste production from animals reared in several covered pens with concrete floors. Hopefully results will be used in setting standards for cattle feedlots. (Bundy-Iowa State)

### 0735-B2, C1, C2, D1, D3, E4

**SECONDARY TREATMENT OF HOG WASTE IN AN ANAEROBIC STABILIZATION POND,**
North Dakota Water Resources Research Inst., Fargo.
Robert G. Butler.
North Dakota Water Resources Research Institute Report WI-221-011-69, December, 1969. 35 p, 4 fig, 11 tab, 44 ref. OWRR Project A-010-NDAK (1).

Descriptors: *Anaerobic conditions, Biochemical oxygen demand, *Oxidation lagoons, Farm wastes, *Bacteria, Waste water treatment, *Anaerobic bacteria, Photosynthetic bacteria, Microorganisms, Chemical analysis.
Identifiers: *Hog wastes.

This study relates the physical and chemical characteristics of the contents of an anaerobic stabilization lagoon to the bacteria that are responsible for the stabilization of the waste. The lagoon is fed by effluent from a settling tank that receives wastes from a hog barn. The lagoon operated as an unheated digester and maintained a pH between 7.2 and 8.1. The Redox potential varied from -370 to -403 millivolts. The mean concentration of volatile acids was 403 mg/l. The average level of BOD for the lagoon water was 566 mg/l. A BOD loading of 3,250 pounds per acre per day did not produce lagoon failure. Sulfate reducers were grown on Postgate's Media E. Methane producing organisms were detected. Photosynthetic organisms were grown on two different media.

### 0736-C3

**SALMONELLA IN WASTES PRODUCED AT COMMERCIAL POULTRY FARMS,**
Rutgers - The State Univ., New Brunswick, N.J.
D. J. Kraft, Carolyn Olechowski-Gerhardt, J. Berkowitz, and M. S. Finstein.
Applied Microbiology, Vol 18, No 5, p 703-707, November 1969. 4 tab, 13 ref.

Descriptors: *Salmonella, *Poultry, Bacteria, Sampling, Pathogenic bacteria, Waste disposal, Farm wastes.

The potential of poultry excreta and manure from commercial farms to contaminate the environment with salmonella was determined. Composite samples of freshly voided excreta from 91 poultry houses were tested qualitatively for salmonella. Twenty-six (29%) were positive. Of the 36 farms tested, 18 showed positive samples. In a separate quantitative study salmonella densities ranged from less than 1 to over 34,000 per gram excreta (dry weight). Those samples from floor and caged birds were comparable with respect to the incidence of salmonella. As shown in a qualitative survey there were distinct differences. High densities of the pathogens were found in fresh excreta from caged but not floor birds. It is concluded that the spreading of these wastes could have disseminated substantial numbers of salmonella onto the soil possibly lending to the contamination of water via surface run-off. It is suggested that the recently developed plow-furrow-cover method of manure application may be advantageous in burying the waste thereby preventing its transport by surface run-off. (Hancuff-Texas)

### 0737-B2, C2, D3, E1

**REDUCTION OF NITROGEN CONCENTRATIONS IN SWINE LAGOON EFFLUENT BY BIOLOGICAL DENITRIFICATION,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. K. Koelliker, and J. R. Miner.
In: Proceedings, Industrial Waste Conference, 25th, May 5-7, 1970, Purdue University, Engineering Extension Series No. 137, Part 1, p 472-480, 6 tab, 11 ref. PHS Grant EC 00283-02.

Descriptors: *Farm wastes, *Denitrification, *Biological treatment, Hogs, Liquid wastes, Effluents, Nitrogen, Anaerobic conditions, Irrigation, Lagoons, Aerobic conditions, Oxidation-reduction potential, *Waste treatment, Waste disposal.
Identifiers: Carbon source, Anaerobic lagoons.

Conventional schemes that treat liquid animal wastes are designed to reduce organic material and to reduce solids volume before final disposal. Removal of nitrogen by such operations is incidental. If such lagoon effluent were released into the environment, problems would arise from the quantities of nitrogen remaining. Because of these problems, or potential problems, with irrigation disposal of anaerobic swine lagoon effluent, a study was undertaken to explore the feasibility of reducing nitrogen concentrations before disposing of the effluent. Reduction of nitrogen concentration by biological denitrification is discussed. The conditions necessary for denitrification are a source of NO3-N, an available organic carbon energy source, a population of denitrifying bacteria, pH 5-9, little or no molecular oxygen, and temperature 5-60 degrees C. There is not sufficient organic carbon in a well-nitrified swine waste effluent, however, adding raw swine manure at a feed rate of BOD5 = 3.26 NO3- N gives an efficiency of nitrogen removal of 91 percent. (Dorland-Iowa State)

### 0738-A2, A4, A5, F6

**MODELING FEEDLOT RUNOFF POLLUTION I. ANALOG SIMULATION,**
Kansas State Univ., Manhattan. Dept. of Chemical Engineering.
S. F. Kang, L. T. Fan, E. S. Lee, and L. E. Erickson.
Transactions of the American Society of Agricultural Engineers, Vol 13, No 6, p 858-869, Nov-Dec 1970. 11 fig, 3 tab, 26 ref. FWPCA WP-0141-02.

Descriptors: *Farm waste, Confinement pens, Computer model, Analog computer, Analog models, Simulation analysis, Runoff, Water pollution, Infiltration, Cattle.
Identifiers: *Dimensional analysis, Dynamic modeling, Feedlot.

The purpose of the investigation outlined is to investigate (feedlot runoff) a more realistic model; namely, a dynamic model represented by a set of nonlinear differential equations using analog computer simulation. Since the feedlot runoff system does not generally remain at steady state, a dynamic model can represent the system more realistically than a static model. For a system of three parameters, fitting data by an analog simulation can be used effectively when high accuracy is not required. However, for a complex system with a large number of unknown parameters, the analog simulation approach can be very tedious and time consuming. The quasi-linearization technique is shown to be a useful tool for estimating parameters in a feedlot runoff system. The advantage of the quasilinearization technique is that, if the process converges, it converges quadratically. This technique has been proved useful not only in parameter estimation, but also in solving nonlinear boundary value problems in partial and ordinary differential equations. The quasilinearization technique also has disadvantages; two of the most important ones are the ill-conditioned problems and the convergence problem. (Bundy-Iowa State)

### 0739-A4, A5, A12

**NITRATE AND WATER,**
Missouri Univ.-Columbia. Dept. of Soils.
M. Christy, J. R. Brown, and L. S. Murphy.
Science and Technology Guide, University of Missouri Extension, Columbia, p 9808-9809, March 1965, 2 fig, 1 tab.

Descriptors: *Farm wastes, Nitrogen, Fertilizers, Legumes, Missouri, Alfalfa, Livestock, *Water pollution sources, *Nitrates, *Public health.

Nitrates in some water supplies have caused concern. A statewide survey showed that animal manures, inadequate sewage systems, and soil organic matter comprised the primary sources of nitrate in water supplies. Even though nitrate has been found in shallow wells all over the state, the largest percentage of such wells have been found in areas with greatest livestock numbers. Other sources include the nitrogen from legumes and fertilizers. Ponds usually have a low nitrate level. On the other hand, water of springs contains nitrate, thought to originate from natural soil leachings and bat guano deposits in nearby caves. The annual flow of some large springs may contain many times more nitrate-nitrogen than the total fertilizer nitrogen used annually in Missouri. The reason for concern is potential health hazards. Nitrate can be especially hazardous to infants. One problem is that boiling will not remove nitrates. (Bundy-Iowa State)

### 0740-A6, A11

**PHOTOGRAPHIC STUDIES OF THE DUNGING BEHAVIOR OF PIGS IN CONFINEMENT,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. P. Hultgren, and T. E. Hazen.
Paper number MC 71-101 presented at the 1971 Mid-Central Meeting of the American Society of Agricultural Engineers, St. Joseph, Missouri, April 16-17, 1971. 15 p, 5 fig, 1 tab, 10 ref.

Descriptors: *Farm wastes, *Animal behavior, *Design criteria, Hogs, Training, Environmental effects, Light intensity, Temperature, Photography, Confinement pens, *Odor.
Identifiers: Dunging behavior, Time-lapse photography, Statistical analysis.

Each year in the United States, an increasingly larger volume of hogs are produced in confinement. Greater and greater emphasis is being placed on the control of offensive odors. Pen and pig cleanliness are important in odor control. Both are largely dependent on defecation behavior and feces placement. A research project was initiated to determine if pigs had a predictable defecation pattern and what housing design factors might influence this behavior. Time-lapse photographic observations on 180 pigs indicated that they spend an average of 81.1 percent of each 24-hour period sleeping, 7.6 percent standing, 10.0 percent eating, 0.9 percent drinking, and 0.4 percent defecating. Tested for effect on the dunging behavior were 3 levels each of air temperature and lighting, and 3 locations of air placement. When statistically analyzed, the treatment differences were seldom significant. The pigs developed some established activity patterns, however, which provide a basis for improved building design and sanitation. (Dorland-Iowa State)

### 0741-A4, A5, B2, B4, D3, E2, F2

**RULES AND GUIDELINES FOR THE CONTROL OF WATER POLLUTION FROM LIVESTOCK CONFINEMENT FACILITIES AND GUIDELINES FOR CONSTRUCTION OF SEALED EVAPORATION AND RETENTION PONDS.**

Colorado Department of Health, Water Pollution Control Commission, Denver, April 10, 1968, 11 p, 3 fig.

Descriptors: *Farm wastes, Feed lots, Confinement pens, *Colorado, Lagoons, Regulation, *Water pollution control.

The Colorado Water Pollution Control Commission established rules for the prevention of water pollution from livestock confinement facilities in the state of Colorado. Guidelines established by the commission are included. Some of them pertain to preliminary considerations, pond surface area, pond storage volume, discharge and percolation, and pond shape, pond fencing and maintenance, land disposal system, embankments and dikes, pond bottom settling tank and biological treatment. (Wallin-Iowa State)

### 0742-A11, C3

**INFECTIOUS PANCREATIC NECROSIS VIRUS: COMPARATIVE FREQUENCIES OF ISOLATION FROM FECES AND ORGANS OF BROOK TROUT (SALVELINUS FONTINALIS),**
Guelph Univ. (Ontario). Dept. of Veterinary Microbiology and Immunology.
C. Frantsi, and M. Savan.
Journal of the Fisheries Research Board of Canada, Vol. 28, No. 7, p 1064-1065, 1971. 1 tab, 4 ref.

Descriptors: *Fish diseases, *Brook trout, *Viruses, Trout, Fish, Bacteria, Fish hatcheries, Fisheries, Fish management, Pollutant identification.
Identifiers: *Stress, Feces, Organs, Infectious pancreatic, *Necrosis virus.

When isolation of infectious pancreatic necrosis (IPN) virus was attempted simultaneously from feces and organs of brook trout, the virus was isolated more frequently from organs than from feces. However, the greater the degree of stress on the fish, the closer the number of isolations from feces appeared to approach that from organs, and the virus was isolated from both organs and feces of each of 10 fish accidentally exposed to low oxygen concentration for 4 days. The findings suggest that masked viral and bacterial infections may be detectable if fish are plaed under stress. (Dorland-Iowa State)

### 0743-A2, E2, F1

**GUIDELINES FOR DEVELOPING COMMERCIAL FEEDLOTS IN KANSAS,**
Kansas State Univ., Manhattan. Cooperative Extension Service.
D. B. Erickson, and P. A. Phar.
Kansas State University, Cooperative Extension Service, Number C-418, (April 1970). 30 p, 2 fig, 20 tab, 15 ref.

Descriptors: *Farm wastes, *Feed lots, Cattle, Economics, Irrigation, Feeds, Runoff, Kansas, Cost analysis.

Guidelines are provided on costs of financing and constructing feedlots. The development of large feedlots handling 10,000, 20,000 and 30,000 head has been inspired by economics of scale and very favorable cattle and feed prices. The average investment for a 10,000 head capacity lot would be about $43.15 per head, while for a 30,000 head capacity lot the requirements drop to about $33.87 per head. The total feed and operating cost per head for each size feedlot is: 10,000 head - $85.36; 20,000 head - $83.89; 30,000 head - $82.24. The expansion of the large feedlots in Kansas will depend on the availability of feed, water, labor and cattle. Some areas will have the capacity to expand faster than others depending on existing grain production and development of irrigation. Shipping grain a considerable distance adds to cost of production. Knowledge of the number of cattle and hogs to be fed, crop production and the location of the market that will return the greatest income to the cattle owners is necessary for an assessment of the local potential for a feedlot. Expansion of the packing industry areas where feeding is increasing creates a greater opportunity for producers to sell their cattle. (Bundy-Iowa State)

### 0744-A4, A5, A6, A7, B2, B3, F2

**ANIMAL SLAUGHTER AND PROCESSING,**
National Industrial Pollution Control Council, Washington, D. C.
S. S. Cross, R. W. Renaker.
Animal slaughtering and Processing National Industrial Pollution Control Council, Sub-Council Report February, 1971, 14 p.

Descriptors: *Farm Wastes, *Industrial Wastes, Air Contamination, Solid Wastes, Wastewater, Regulations, By-Products.
Identifiers: *Rendering, Animal Processing Wastes, Poultry and Animal Products.

The United States poultry and animal products Industries include approximately 7,500 establishments. The pollution problems of these industries cover the normal range of water, air, and solid pollutants. Substances collected in the process water include organic matter from blood, meat, or paunch contents, fats, oils, grease, nutrients, and dissolved inorganic solids. The rendering industry considers objectionable odors from edible and inedible rendering operations as its primary pollution problem. Ground manure is the principal solid waste from feedlot operations. New technology is needed to develop a standard water sampling procedure, design a program to identify where nutrient losses are occuring in processing operations, and design a program to study the effects of reduced water usage. The poultry and livestock - based industries have long demonstrated an awareness and a concern for environmental problems and have voluntarily initiated programs to develop corrective procedures. Government policies should continue to encourage and assist these industries in the identification and solution of major pollution problems. (Schmitt - ISU).

### 0745-B2, B4, E2, E3

**ANIMAL WASTES.**
National Industrial Pollution Control Council, Washington, D.C. Staff Report, February 1971. 15 p, 1 fig, 2 tab, 9 ref.

Descriptors: *Farm wastes, *Industrial wastes, Flow control, Byproducts, Waste storage, Pollution abatement, Water pollution sources.
Identifiers: *Animal processing wastes, Rendering.

Increased pollution from animal wastes is attributable to two of the fundamental factors behind most pollution problems – population increase and the adoption of more efficient production or processing methods. Farm animals produce over one billion tons of fecal wastes and 400 million tons of liquid excrement per year, with a human population of BOD equivalent of over 2 billion persons. Animal processing wastes frequently include blood, paunch contents, and clean-up materials. Only about 40% of a beef animal slaughtered for human food is considered edible. The rendering process, which involves the cooking of various types of carcass materials, is a significant source of pollution. Remedial actions being undertaken to deal with the animal waste problem include construction of water diversion structures around livestock feedlots and excrement collection in large storage tanks for later return to the land. Currently, research is under way to assess the use of chicken litter as a feed for ruminants. Pollution control in the meat packing industry is largely a matter of by-product recovery. Blood recovery, paunch handling, edible rendering, inedible rendering, and clean-up are the five key recovery processes. Completely enclosed animal factories with complete control of inputs and outputs are expected to become a reality in the not too distant future. (Schmitt-Iowa State)

### 0746-B2, C1, D1, D3, E3, F1, F5

**RECYCLING SYSTEM FOR POULTRY WASTES,**
Lake Tahoe Area Council, Tahoe City, Calif.
G. L. Dugan, C. G. Golueke, and W. J. Oswald.
Journal Water Pollution Control Federation, Vol. 44, No. 3 p 432-440, March 1972, 3 fig, 2 tab, 9 ref.
EPA Grant 5R01 U100566-03.

Descriptors: *Farm wastes, Poultry, Nitrogen, Lagoons, Pumping, Aerobic treatment, Biochemical oxygen demand, Chemical oxygen demand, Nutrients, *Waste treatment, *Algae, Costs.
Identifiers: *Oxidation ditch, Hydraulic manure handling.

An integrated waste management system was developed in which animal enclosure sanitation was integrated with waste treatment. It was a largely closed hydraulic system involving an anaerobic phase and an aerobic phase in which oxygenation could be accomplished either by the photosynthetic activity of algae or by mechanical aeration. When photosynthetic oxygenation was used, algae were harvested. The range of application of the process is from small-scale to large-scale operations. Algae reclamation would be practiced in large-scale operations and induced aeration in smaller ones. An important operational feature of the system is to keep the solids content of the manure slurry to less than 3 percent, wet weight. At concentrations of 3 percent or less, 70 percent or more of suspended solids in manure slurries settle out of suspension in less than 30 min. Pond depth should not exceed 12 in. (30.5 cm). The indicated pond area per bird was 2 sq. ft. (0.19 sq. m.). An economic evaluation based on an integrated system of 100,000 egg layers and the application of the low-loading, high-cost, and over-designed components used in the research indicates that the waste-handling costs of the system would be at the most, $0.02/dozen eggs. If the value of the algal crop were credited to the operation, the net waste-handling cost would be about $0.01/dozen eggs. (Bundy-Iowa State)

### 0747-A2, B2, B3, C1, C2, C3

**ALTERNATIVES IN CATTLE FEEDLOT WASTE MANAGEMENT,**
Iowa Univ., Iowa City. Dept. of Civil Engineering.
R. R. Dague.
In: Proceedings, Industrial Waste Conference, 25th, May 5-7, 1970, Purdue University, Engineering Extension Series No. 137, Part 1, p 258-265, 1 fig, 17 ref.

Descriptors: *Farm wastes, *Waste treatment, *Design criteria, Runoff, Waste water disposal, Waste water treatment, Waste disposal, Physical properties, Chemical properties, Biological properties, Control systems, Economic feasibility, By-products, *Feed lots, Cattle.
Identifiers: Population equivalents, Pollution potential.

In the 32 leading cattle-feeding states there are about 200,000 cattle feedlots. In 1967, the 22 million cattle produced in these feedlots produced about 200 million lb/day (dry weight) of manure. The control practices employed in a given region or state may be necessary and effective in that area but be unnecessary or ineffective in another area. The form of the wastes as they enter the environment may bear only a slight resemblance to what they are like when fresh. The manure accumulation on the feedlot surface is one waste--the runoff is another. The expression of animal waste quantities in terms of human population equivalents is very misleading, the important factor is the amount and characteristics of the material that actually enters the stream. The steps that should be involved in solving feedlot waste problems are: (1) Can the waste volume and/or strength be reduced at the source. (2) Can the physical, chemical, and biological characteristics of the waste be improved at the source. (3) Is it possible and feasible to recover by-products from the waste. (4) What systems will most economically accomplish the necessary degree of waste control or treatment. Management of the manure and the runoff are discussed. (Dorland-Iowa State)

### 0748-A6, B3, C2, D1, D2

**THE ELIMINATION OF ODOUR FROM THE EFFLUENT GASES OF CHICKEN MANURE DRYING PLANT,**
Loughborough Univ. of Technology (Ontario).
A. S. Hodgson.
Journal Agriculture Engineering Research, Vol. 16, No. 4, p 387-393, December 1971, 3 fig, 1 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, Dehydration, *Drying, Feed, *Waste treatment.
Identifiers: Pilot experiment, Waste gas, Scrubber, Cyclone separator.

Practical means of reducing odor from a chicken manure drying plant waste gas stream were investigated. The cause of the odor and possible means of removal from the waste gas were studied. Although odor removal was possible, the cost is high. The problem should be considered during the plant design stage. A chicken manure drying plant must be designed initially with the problem of effluent gas odor of primary importance. For the plant studied, operation was consistent with the operating manual. Recycle rates were lower than expected which may increase the odor problem. The odor in the gas stream from the chicken manure plant is caused by ammonium salts of carboxylic acids, free acids and neutral material and possibly other material. The drying of chicken manure must be accomplished in a system which does not produce gaseous effluent with strong odor. The ultimate result of not considering the odor problem at the initial design stage is to risk having the plant shut down as a public nuisance. A closed system is probably the only satisfactory method for overcoming this problem. Modifications to a plant for odor removal are difficult and expensive. (Bundy-Iowa State)

### 0749-A6, A7, B2, D3, F1

**ROTOR AERATION OF SWINE WASTES,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. L. Day, J. C. Converse, and D. D. Jones.
Illinois Research, University of Illinois Agricultural Experiment Station, p 16-17, Spring, 1968, 4 fig.

Descriptors: *Farm wastes, *Oxidation, Aeration, Hogs, Gases, Odors, Confinement pens, Ammonia, *Waste water treatment, Costs, Waste treatment.
Identifiers: *Oxidation ditch, Foaming, Rotor aeration.

Laboratory tests on aeration of hog wastes indicated that it might be feasible to develop an oxidation ditch in a confinement swine house. With this method, self-cleaning slotted floors could be used without objectionable gases and odors coming from the gutter. Eighty pigs averaging 120 pounds were used. The gutter was filled with tap water, and 100 gallons of activated sludge from the Urbana waste-treatment plant was added as an inoculum at the beginning of the test. The major problem was foaming which began during the fifth week of operation. On the basis of an electricity rate of 2 cents per kilowatt hour, the power to furnish the proper oxygen supply costs about a half a cent per pig per day. During the second test, a rotor with a 3/4-horsepower motor was used to supply 0.9 pounds of oxygen per pig per day. Foaming was not as serious as during the first test. On the second test, an ammonia odor was very evident in the building, and appeared to be coming from the aerated waste. This odor subsided, however, during the ninth week and did not recur. Before the oxidation ditch can be unconditionally recommended for swine confinement buildings, several problems must be solved. The most immediate of these is the control of foaming. (Bundy-Iowa State)

### 0750-A6, B2, C1, C2, D3

**LAGOONING OF LIVESTOCK WASTES IN SOUTH DAKOTA,**
South Dakota State Univ., Brookings. Dept. of Civil Engineering.
J. N. Dornbush, and J. R. Andersen.
In: Proceedings, Industrial Waste Conference, 19th, 1964, Part 1, p 317-325, 2 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Lagoons, Anaerobic conditions, Aerobic conditions, Poultry, Biochemical oxygen demand, Chemical oxygen demand, Ammonia, Nitrogen, *South Dakota, Waste water treatment.
Identifiers: *Dry solids, Volatile solids, Cages.

Current studies of lagoons in South Dakota have elucidated some of the basic factors influencing the design and operation of farm manure lagoons in a northern climate. To serve as an economical final method of disposal of farm manures, the lagoons must maintain anaerobic biological action and should be loaded on a volatile solids (VS) basis as are other sludge digesters. A loading rate of five to 10 lbs of VS per 1,000 cu. ft. of lagoon volume has been found satisfactory where winter conditions result in storage of manures for prolonged periods. Mixing the lagoon contents to disperse sludge deposits appears essential to avoid offensive odors. An adequate water depth to facilitate mixing is desirable and lagoon depths of five to eight ft. warrant consideration. (Bundy-Iowa State)

### 0751-A11, D2, D3, E3

**ANIMAL WASTE VALUE-NUTRIENT RECOVERY AND UTILIZATION,**
Alabama Agricultural Experiment Station, Auburn. Dept. of Animal Sciences.
W. B. Anthony.
Journal of Animal Science, Vol. 32, No. 4, April 1971. p 779-802. 46 ref.

Descriptors: *Farm wastes, *Poultry, Swine, Cattle, Feed lots, *Waste treatment, *Waste disposal.
Identifiers: *Packing house wastes.

Livestock organic waste far exceeds the organic waste output of the human population in the United States. Livestock waste can be converted into a great resource but most waste management research is concerned with humans. However, some research has been done on using poultry waste as a feed or feed component. Tests have been made on the feeding of autoclaved poultry manure (APW), cooked poultry manure (CPW), and soybean meal (SBM) to wethers and steers. Poultry manure has also been used indirectly for chick feed. In Britain, the feeding of poultry manure to sheep and cattle seems to have been widely accepted. In addition to poultry, waste management research has been carried out on pigs and cattle. Dried pig feces have been inserted into swine finishing rations and have been fed to swine. Steer manure has been an acceptable component of swine rations and in recent years has also been used for cattle feeding. The feeding of steer manure to cattle has proven satisfactory because it (1) largely eliminated noxious accumulation of manure in the feedlot, and (2) improved the efficiency of the cow as a converter of feed to human food. To avoid harvesting steer manure each day to blend with the grain prior to feeding, the wastelage concept was developed. Wastelage is the conversion of feedlot manure into silage. Manure may also be made useful for feed by yeast fermentation or by lactic acid fermentation. (Bundy-Iowa State)

## 0752-A2, B1, F1

### ROLE OF THE SOIL CONSERVATION SERVICE IN DESIGN OF FEEDLOT WASTE MANAGEMENT FACILITIES,

Soil Conservation Service, Lincoln, Neb.
D. R. Vallicott.
(1970), 2 p.

Descriptors: *Farm wastes, *Design criteria, Construction costs, Cost sharing, *Standards, Runoff, Government supports.
Identifiers: *Feedlot runoff, *Soil Conservation Service, Runoff control.

The Soil Conservation Service works with farmers and ranchers in the planning and installation of soil and water conservation practices on their farms or ranches and, since feedlot runoff control can be effected by the installation of a system of conservation practices, it comes within the scoope of Soil Conservation Service responsibility. Assistance to the farmer or rancher comes from three sources: the Extension Service, the Soil Conservation Service, and the Agricultural Stabilization and Conservation Service for cost sharing where applicable. The Soil Conservation Service has, based on its knowledge in the design and performance of certain conservation practices, prepared an Engineering Standard and Specification for what has been termed 'Feedlot Runoff Control'. The standard has been prepared using what are considered proven methods and procedures. It is anticipated that improvements will be made as other methods and procedures are proven to be sound. (Dorland-Iowa State)

## 0753-B3, D3, E3, F1

### MANURE CAN BE PROCESSED AND SOLD AT A PROFIT

Agricultural Extension Service, University of California, Los Angeles.
J. Van Dam, and C. A. Perry.
A Publication of the Dow Chemical Company, The Practicing Nutrionist, Vol. 3, No. 4, pp. 40 & 42.

Descriptors: *Farm wastes, *Feedlot, *cattle, market value, waste disposal.
Identifiers: *Los Angeles County, Composting, stockpiling, packing cost.

A study to determine the actual cost of removal and disposal of manure from a beef feedlot in Los Angeles County was made by the Agricultural Extension Service. Manure was prepared for marketing in three basic forms and sold under four pricing conditions. Manure processing, packaging and marketing began with the mounding of the manure in the corrals, followed by its removal to a compost stockpile. Based on the volumes of the different product forms handled in the feedlot studied, the composted unprocessed manure had the greatest market potential. However, the processed bulk product had the greatest net revenue based on net returns, product form volumes and weighted average price, less total costs. While this study was not intended to determine the market for manure, it did determine that there was a market for various product forms - all within a competitive price range, and it is probable that a feedlot operator can make a profit from the sale of manure. (Bundy - ISU).

## 0754-A4, A9, B2, D3, E1, E2

### WASTE WATERS FROM FARMS.

Department of Scientific and Industrial Research, Notes on Water Pollution No. 17, June, 1962, 4 p, 11 ref.

Descriptors: *Farm wastes, Irrigation, *Waste disposal, Biochemical oxygen demand, Nitrogen, Biological treatment, *Waste water treatment.
Identifiers: *Soakaways.

Disposal of waste waters from farms has become a major problem as farmers have turned away from bedding down animals. Methods of disposal suggested include irrigation on land, soakaways, discharge to a sewer, and biological treatment and discharge to a stream. Silage liquor, herbicides, and pesticides all create a disposal problem. Consulting the local water quality authorities is usually the best procedure before attempting to dispose of liquors capable of water pollution. (Wallin-Iowa State)

## 0755-B2, C1,C2, D1, D3, E2

### FEED LOT WASTE IN FLORIDA,

Orange County Pollution Control Dept., Orlando, Fla.; and Soil Conservation Service, Orlando, Fla.
C. W. Sheffield, and B. Beville.
In: Proceedings, Industrial Waste Conference, 25th, May 5, 6, and 7, 1970. Purdue University Engineering Extension Series No. 137, Part 2, p 914-918, 1 fig.

Descriptors: *Waste treatment, *Biological treatment, *Waste disposal, Subsurface drains, Sprinkler irrigation, Aerobic treatment, Anaerobic digestion, Dairy industry, Cattle, Biochemical oxygen demand, Turbidity, Retention, *Farm wastes, *Feed lots, Costs.
Identifiers: Grit chambers, Polishing ponds, Sand traps.

The problems associated with animal waste disposal are becoming tremendous compared to just a few years ago. An increased number of animals has created a problem of wastes from feedlots. It has been estimated that animal waste is ten times that from human waste, or approximately 55 pounds of manure per person would be one way of estimating the amount of manure from a feedlot operation. Therefore, it could be assumed that approximately two pounds per day of BOD as runoff is associated per steer or cow. Various methods of treating animal wastes from feedlot operations were reviewed and the most practical and economical means of treating the waste from dairy and beef cattle was determined. Construction and maintenance costs for a waste treatment facility for 800 dairy cows is presented. The treatment method consists of a grit chamber followed by an anaerobic pond, then an aerobic pond and a polishing pond. The effluent is discharged through a three to five acre sub-surface drain and a five acre spray irrigation system. (Dorland-Iowa State)

## 0756-A2, A3, A4, A5, A6, B1, F2

### SWINE-WASTE MANAGEMENT,

Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. G. Jedele, and D. L. Day.
Paper No. 69-934, presented at the 1969 Winter Meeting of the American Society of Agricultural Engineers at Chicago, Illinois, 4 p.

Descriptors: *Farm wastes, *Legal aspects, *Design criteria, Hogs, Odor, Treatment facilities, Water pollution, Water quality, Design standards, Specifications, *Waste water treatment.
Identifiers: *Odor control, Stream pollution, Guidelines.

Producers of livestock are experiencing difficulties in the design of waste treatment facilities. These producers, motivated by a desire to avoid lawsuits or a desire to be good neighbors, are hard pressed to determine exactly how much treatment and what type of treatment is needed to prevent objectionable odors and stream and groundwater pollution. Most references and guidelines contain terms such as 'if you are not too close to your neighbors' and 'they sometimes release objectionable odors.' Producers want to know such things as how close is close and just how objectionable are the objectionable odors. Producers need to know their chances of being the object of a lawsuit or producing runoff that will result in pollution to water. Some type of guideline is needed to tell a producer what type of treatment he needs to satisfy his circumstances. (Dorland-Iowa State)

## 0757-A4, A6, B2, C2, D3, E1

### AEROBIC TREATMENT OF SWINE WASTE

Research Associate, University of Illinois, Urbana.
R. L. Irgens, and D. L. Day.
In: Illinois Research, University of Illinois Agricultural Experiment Station, Fall 1965, pp. 14 - 15, 2 fig.

Descriptors: *Farm Wastes, Aerobic Treatment, Swine, Confinement Pens, Aeration, Biochemical Oxygen Demand, Chemical Oxygen Demand, ammonia, nitrate, phosphate, hydrogen Ion Concentration, 0dor.
Identifiers: *Moorman Swine Research Farm,

A laboratory investigation was made to determine: How well can swine waste, which is more concentrated than municipal waste, be stabilized by aerobic treatment. How much must the liquid manure be diluted to obtain satisfactory results? How much air is required for the process of aerobic stabilization? Aerobic treatment of swine waste proved to be odor free and did not attract flies. Carbon dioxide was the only gas produced. The effluent had a low BOD, 12 to 20 ppm which will not pollute streams if discharged into them. Results of these experiments gave the following design requirements for an aerobic treatment plant: Volume in aeration tank or ditch — 6 cubic feet per pig; quantity of air required — 2500 cubic feet per pound of BOD at 3 percent efficiency of oxygen utilization. In the laboratory treatment system, results were more satisfactory when small amounts of manure were added daily than when large amounts were added weekly or monthly. It was thus concluded that odorless aerobic treatment could be integrated with self-cleaning slatted floors so the pig excreta would be deposited directly into the treatment plant. The manure collection gutters could be connected at the ends to make a continuous channel and an aerator would keep the solids suspended, circulate the liquid manure, and add the necessary oxygen. Facilities to field - test this method are being constructed. (Bundy-ISU).

## 0758-A2, A4, A5, B2, D3, E2, F3

### HANDLING AND DISPOSAL OF CATTLE FEEDLOT WASTE,

Texas Tech Univ., Lubbock.
R. C. Albin.
Journal of Animal Science, Vol. 32, No. 4, April 1971. p 803-810. 2 tab, 71 ref.

Descriptors: *Farm wastes, *Feed lots, Cattle, Water pollution, Biochemical oxygen demand, *Waste disposal, *Oxidation lagoons, *Waste

water treatment.
Identifiers: Liquid handling systems, Anaerobic lagoons.

The exponential expansion of cattle feeding in the United States during the last decade has created many challenges, among which are the handling and disposal of a by-product, feedlot waste. It can be categorized as solid or semi-solid waste and runoff water for most feedlots, or as a liquid suspension from confined feeding operations. The chemical and pollutional characteristics are variable. Numerous handling and disposal systems are available for management of cattle feedlot waste. The disposal system for a commercial feedlot could be characterized as a function of several parameters, such as climate, type of ration and cattle, feedlot surface, and cattle and human population densities, with the solution stated in economic equivalents. Final disposal of feedlot waste has been on the land in most instances. The oxidation ditch and a combination of aerobic and anaerobic systems offer possibilities. Socio-industry relationships might require ultimate disposal of runoff and effluent into streams with dehydration and/or incineration of the solid waste. Use of feedlot waste as a resource material offers unlimited possibilities as a conservation approach to feedlot waste management. The need for research in feedlot waste management is urgent. Critical evaluations of handling and disposal systems for cattle feedlot waste are needed in the areas of land use, socio-legal-industry relationships, environmental pollution, conservation and economics. (Bundy-Iowa State)

### 0759-A2, A4, C2, C3

**STREAM POLLUTION FROM FEEDLOT RUNOFF,**
Kansas State Dept. of Health, Topeka. Environmental Health Services.
J. L. Mayes, S. M. Smith, and J. R. Miner.
Paper presented at the Fourteenth Annual Conference on Sanitary Engineering, University of Kansas, Lawrence, January 8, 1964. 24 p, 4 fig, 8 tab.

Descriptors: *Farm wastes, Feed lots, Kansas, Runoff, Biochemical oxygen demand, Chemical oxygen demand, Ammonia, Nitrogen, Fishkill, Cattle, *Agricultural runoff, *Water pollution sources, *Water pollution effects.

During the investigation of water pollution complaints and fish kills, the Kansas State Department of Health has found animal feedlot runoff to be the cause of a number of water pollution problems. The principal problems have occurred in water courses below feedlots where large numbers of farm animals, primarily cattle, are concentrated in feeding areas. Water pollution studies of streams polluted with feedlot runoff indicate that the runoff is characterized by a high biochemical oxygen demand, high ammonia content, and heavy bacterial populations. The pollution problem is intermittent since it occurs during the following runoff, but it causes a severe slugging effect on the stream. Serious depletion of the dissolved oxygen content of the stream may occur, especially if the stream is small or the waste load is large. Present knowledge does not allow a quantitative prediction of the degree of pollution that can be expected from a given feedlot operation on a given occasion. This seems to be dependent upon a variety of factors such as the size of the lot; the cleanliness of the lot when runoff occurs; general topography of the area and the location of the lot with respect to receiving waters; the amount of rainfall, its intensity and pattern within the drainage basin; the size of the receiving stream and the pollution control measures in use. (Bundy-Iowa State)

### 0760-A11, B1

**HIGH TEMPERATURE ENVIRONMENT EFFECTS ON GESTATING SWINE,**
Oklahoma Agricultural Experiment Station, Stillwater.
G. W. A. Mahoney, I. T. Omtvedt, D. F. Stephens, E. J. Turman, and R. Edwards.
Paper presented at Annual Meeting of the Southwest Region, American Society of Agricultural Engineers, April 3-5, 1968, Baton Rouge, Louisiana, 14 p, 3 fig, 3 tab, 3 ref.

Descriptors: *Farm wastes, Confinement pens, *Swine, Ventilation, Cooling, *Temperature, *Environmental control.
Identifiers: *Slotted floor, Farrowing, Control chamber.

The objectives were to investigate the effect of high ambient temperatures on swine prior to breeding and during gestation on the estrual cycle, conception rate and subsequent embryo survival; to attempt to determine the 'critical' periods of temperature stress prior to breeding and during gestation for subsequent testing; and to evaluate the performance of the environmental chambers constructed for this study. There was a definite tendency toward reduced corpora lutea, fewer viable embryo, lower survival rates and smaller embryos for the gilts in the heat stress chamber. The differences were significant ($p < 0.05$) for reduced viable embryo and survival rates for gilts stressed 1-15 days postbreeding. Rectal temperatures were significantly higher for gilts in the heat chamber. Also, six gilts, of the 32 in Trials 1 and 11, died due to heat prostration. The environmental chambers performed satisfactorily but needs some modification and improved instrumentation and controls. Humidity controls are needed so effects of environment with various high humidities and temperatures can be investigated. Present modifications of the heating system are currently in progress and should result in better control of high temperatures and result in more uniform temperature, rather than the present 6 degrees variation, or plus or minus 3 degrees above and below 102 degrees F. (Bundy-Iowa State)

### 0762-A6, B2, B3, B4, C1, C2, C3, D1, D3, E2, E3, F1, F2

**LIVESTOCK WASTE MANAGEMENT AND POLLUTION ABATEMENT.**

Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, American Society of Agricultural Engineers, St. Joseph, Michigan, 1971, ASAE Publication PROC-271, 360p.

Descriptors: *Farm wastes, *Odors, Economics, Drying, *Aerobic treatment, Runoff, Cattle, Swine, Poultry, Dust, *Aerobic lagoons, Hydraulic structures, Water pollution control, Waste water treatment, Waste disposal, *Pollution abatement.
Identifiers: *Solid-liquid separation, Canada, Europe, *Anaerobic lagoons.

The proceedings of the International Symposium on Livestock Wastes includes approximately 100 papers. The topics include waste disposal systems, beef feedlot systems, legal and administrative considerations, characteristics, hydraulic transport, composting, drying, economics, aerobic treatment and storage, land disposal, refeeding, and solid-liquid separation. Contributions were received from Canada and Europe, as well as the United States. Each paper attempted to demonstrate techniques that allow the coordination of various waste treatment units into workable systems. Research of more than 200 scientists from 30 states and 9 nations was reported. Some were rather novel approaches that might be several years from acceptance and others are modifications of known technology with good prospects for more immediate acceptance.
(Bundy-Iowa State)

### 0763-A6, A12, B1, C2, E2, F1

**ANIMAL WASTES AND AMERICA THE BEAUTIFUL,**
Department of Agriculture, Washington, D.C.
N. D. Bayley.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 6-7.

Descriptors: *Farm wastes, Confinement pens, Odors, Nutrients, Pathogens, Waste disposal, Economics, *Research priorites.

Along with the moving of animals from open range to confinement pens came waste management problems including odors, nutrients, and disease. All of these should be managed in such a way to make America more beautiful and a better place to live. The highest item on research priorities should be to find more and better ways to dispose of organic wastes on land. The next priority should be to control odors from wastes. Very little is known about this problem. A third priority for research should be to look at the entire technology required to deal with animal wastes. This would include starting with the feed produced for the animal to the disposal of the animal waste. Research must be able to evaluate all costs and benefits - tangible values such as outdoor recreaction and fish and wildlife enhancement, secondary benefits that are to some extent quantifiable, such as benefits to the economy - local, regional, or natural and intangible benefits we have not always considered, such as the preservation of natural beauty.
(Bundy-Iowa State)

### 0764-A12, F1

**FUTURE PROSPECTS FOR ANIMALS AGRICULTURE,**
Ohio State Univ. Columbia. Coll of Agriculture and Home Economics,
R. M. Kottman, and R. E. Geyer.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 9-18, 18 tab.

Descriptors: *Farm wastes, Economics, Income, Agriculture, Livestock, Poultry.
Identifiers: Diet-health relationships.

The opportunity for U.S. animal agriculture to provide larger supplies of all animal products during the next 30 years offers an exciting challenge. United States animal agriculture will however, face stiff competition from other food sources, but such competition will assist the U.S. animal agriculture by forcing it to remain progressive. To remain competitive, United States livestock and poultry producers, as well as processors of animal products are challenged to: (1) produce continually higher quality products on the farm with greater eficiency; (2) develop and implement dramatic new methods to control pollution and to utilize waste resources; (3) develop new, low-cost, convenient and tasty foods from animal sources; (4) encourage expansion of research designed to eliminate current unknowns regarding diet-health relationships; (5) DEVELOP AND IMPLEMENT NEW AND GREATLY EXPANDED PROGRAMS TO EDUCATE CONSUMERS AS TO THE HEALTH AND NUTRITIONAL PROPERTIES OF ANIMAL FOODS; (6) substantially increase industry-wide consumer marketing programs, especially zeroing in on the markets for protein, calcium, iron and other animal-derived nutrients essential to human growth and health. (Bundy-Iowa State)

### 0765-B1, F2

**ROLE OF STATE DEPARTMENTS OF AGRICULTURE IN PROBLEMS OF ANIMAL WASTE MANAGEMENT,**
National Association of State Departments of

Agriculture, Washington, D.C.
S. Cath.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p. 21-22.

Descriptors: *Farm wastes, *Federal Governments, *State Governments, *Local Governments, Regulation, Control, Research priorities, Waste disposal.

State Departments of Health, Agriculture, and Environmental Protection, and Livesfock Sanitary Commissions are some of the agencies that put regulations and control on cattle, hog, sheep, and poultry operations. The National Association of State Departments of Agriculture, at their 1969 convention, in resolution form, urged that the Secretary of Agriculture and the land-grant universities give a higher priority to waste disposal and requested the Congress to provide additional funds to carry out the necessary research. Also, the State and Local Governments must develop methods to prevent farm-urban confrontation on the waste and pollution problem. In the practical sense however, good regulatory enforcement of livestock waste disposal can only proceed as fast as the results of good research. Regulatory enforcement should never exceed the state of the art. Livestock industries should not have to cope with unfair regulatory demands that cannot be met.
(Bundy-Iowa State)

### 0766-A7, A9, B1, F1

**RESPONSIBILITIES OF A PROFESSIONAL SOCIETY TOWARD URGENT SOCIAL PROBLEMS,**
Texas A and M Univ. College Station. Dept. of Agricultural Engineering.
R. E. Stewart.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 23-24.

Descriptors: *Technology, Engineering, Air pollution, *Social needs, Environment, Urbanization.
Identifiers: *American Society of Agricultural Engineers, *Professional societies.

Today is an age of growing doubt and mistrust of technology. Many of the benefits technology has brought to the West (and they are many) are being downgraded by the increasing concern over pollution, ugly environment, exploited resources, and disregard of human values. The engineer is increasingly cast in the role of a mindless villain for whom efficiency is measured only by dollar profits and losses. The dilemma, as it appears to be posed for the American Society of Agricultural Engineers (ASAE) and the community of agricultural engineers, is examined from the two viewpoints of urbanization and environmental quality; both of these factors represent urgent contemporary social problems. ASAE could help to reduce the urban crisis by turning massive attention to rural development, including redeployment of industry into the countryside. ASAE could help to solve the environmental problems by increased zeal in working with the public on chemical pesticides, wastes recycling, soil erosion, and wiser exploitation of natural resources. Such effort must be supported by the will of the people, as expressed through the public budgets. The benefits of such work should be at least equal to those derived from the mighty efforts applied to outer space. Moreover, this can be done without sacrifice of any capacity for food production.
(Bundy-Iowa State)

### 0767-B1, F1, F3

**PUTTING IT ALL TOGETHER,**
N. H. Curry.
In: Livestock Waste Managmement and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 25-26.

Descriptors: *Federal government, State governments, Budgeting, Design, Engineering, *Research and Development, *Planning, *Projects, *Project planning, Facilities, Bids.
Identifiers: Contractors.

The normal steps in the development process - from project conception to new facilities operation - for institutionally or corporately-owned research and demonstration installations, as well as privatley or corporately-owned waste treatment and handling units used in production operations. Some predictable problems and pitfalls are discussed. Due to the long process of development, many changes may be anticipated as the project plans develop. These include: (1) a general upgrading of the proposed quality of construction and the incorporation of more sophisticated equipment; (2) a better relation of the project facility design with the statistical design and operational procedures of the proposed experiments, or an improved solution to practical problems in a production facility (the time delay is not all bad); (3) changes in research, administrative, and elective official personnel; (4) project expansion or development of interdisciplinary programs; (5) continued construction cost inflation; (6) competition for funds with other projects; (7) a tendency of administrators in dealing with state legislatures or congress to 'horse trade', or drop smaller projects in order to assure obtaining the 'big ones.' This is not necessarily bad from an overall standpoint - few administrators are promoted for thinking small - but this is faint consolation to the individual or group badly in need of a new facility.
(Bundy-Iowa State)

### 0768-B2, B3, B4, D1, D2, E2, F1

**SYSTEMS FOR THE DEHYDRATION OF LIVESTOCK WASTES: A TECHNICAL AND ECONOMICAL REVIEW,**
H. G. Scholz.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p. 27-29, 5 fig, 2 tab.

Descriptors: *Farm wastes, *Biological treatment, Aerobic treatment, Anaerobic digestion, Swine, *Dehydration, Drying, Liquid wastes, Poultry, Wastes water treatment, Economics.
Identifiers: *Humus manure.

Both biological decomposition and incineration result into a final product which is not marketable. On the other hand, dehydration followed by pulverization of livestock wastes offers the possibility of a product which can be bagged and sold as soil amendment. It is even possible, under European conditions, to have the returns from such a system redeem the capital and operating cost of the plant. Such a system has been designed and is in operation in Europe. In this system, wastes are homogenized and then conveyed to a rotary drum drier. Moisture is removed, and the dried material is conveyed to a cyclone and baged. Flue gas is scrubbed by pumping fresh liquid manure from the building into a verturi scrubber. Manure, heated through contact with the flue gas, falls, into a storage tank which is also used to aid in reducing the moisture content of the manure. The contents of the tank are mixed thoroughly to increase the evaporation surface area of the liquid. This mixing also helps homogenize the manure before it is pumped into the rotary drum. Wastes from poultry, dairy cattle and swine need be treated differently before the drying takes place. Different designs incorporating such pretreatments are described and illustrated with photos.
(Bundy-Iowa State)

### 0769-B1, B4, E2, F1, F6

**A COMPUTER MODEL FOR STORAGE AND LAND DISPOSAL OF ANIMAL WASTES,**
Florida Dept. of Agricultural Engineering. Univ., Gainesville.
R. A. Nordstedt, H. J. Barre, and E. P. Taiganides.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p. 30-33, 6 fig, 4 ref.

Descriptors: *Farm wastes, Computer models. Mathematical model, Waste storage, *Waste disposal, Optimization, Nutrients, Model studies, *Scheduling.
Identifiers: *Manure spreading, Tank wagon, Fortran IV Language.

A model was developed for optimizing and studing long-term scheduling decisions for removing livestock wastes from storage and spreading them on agricultural lands. The storage and land disposal system was modeled as a multistage decision process. Dynamic programming techniques were used to find the optimal disposal schedules (time and quantities). The maximum quantity which can be disposed in each time period is constrained by storage capacity, quantity of waste generated and land area available for spreading the wastes. An important feature of this model is that most parameters are permitted to be functions of time. Transport vehicle capacity, operation times, and cost of labor are not as significant as fixed storage cost, but they were sufficiently important to merit consideration in the design and operation of the system. Land availability and nutrient effectiveness (as compared to inorganic fertilizers) as a function of time were also significant. The model is sufficiently flexible for use as a decision tool in the design of operational systems as well as for use as a simulation tool in studying storage and land disposal systems. (Bundy- Iowa State)

### 0770-A2, A3, A4, A5, B2, B3, D3, E2

**LIVESTOCK WASTE MANAGEMENT AND THE CONSERVATION PLAN,**
Soil Conservation Service, Washington, D. C. Engineerineering Div.
C. E. Fogg.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p. 34-35, 2 tab, 8 ref.

Descriptors: *Farm wastes, Aerobic lagoons, Liquid wastes, Federal Governments, Local Governments, State Governments, Groundwater, Runoff, Biochemical oxygen demand, Irrigation systems, *Waste disposal, Waste water treatment.
Identifiers: Anaerobic lagoons, Health agencies.

Waste management systems must provide for utilization or disposal of livestock wastes without pollution or surface or ground waters and without objectionable odors. A sound system should (1) divert clean water away from areas where livestock wastes are concentrated, (2) provide controlled drainage of runoff from such areas, (3) PREVENT LEACHING OF CONTAMINANTS INTO GROUND WATER, (4) collect polluted runoff; and (5) treat or safely dispose of collected runoff. Solid manure should be removed and stockpiled until it can be safely spread on the land or deposited in the land. Liquid manure resulting from many dairy, swine and poultry operations as well as polluted runoff from concentrated livestock areas can often be disposed of by a water spreading or irrigation system utilizing the soil and plant cover for treatment. Nutrients in such wastes are used by the plants or tied up in the soil provided amounts applied are kept within recommended limits. Aerobic and anaerobic lagoons used singularly or in combination often provide at least partial treatment of liquid manure wastes.

They are usually supplemented by application of the effluent to the land by land spreading or irrigation. (Bundy-Iowa State)

### 0771-B1, E2, F1

**TECHNOLOGICAL AND TECHNICAL CONCEPTIONS OF MANURE HANDLING IN CZECHOSLOVAKIA,**
Vyzkumny Ustav Zemedelske Techniky, Repy (Czechoslovakia).
M. Velebil.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 36-38, 4 fig., 2 tab., 1 chart.

Descriptors: *Farm wastes, Cattle, Litter, *Waste disposal, Cleaning, Hogs, Economics.
Identifiers: *Czechoslovakia, Barn cleaning, Slatted floor.

The technology and techniques of handling swine and dairy manure are discussed. Results of laboratory and field research and experimentation, theoretical analyses and conceptions, and economical evaluations are included. Manure removal from the stables and its application on the field are described. (Bundy-Iowa State)

### 0772-A4, A6, A7, B2, B4, E2

**A LAND RECYCLING LIQUID MANURE SYSTEM FOR A LARGE-SCALE CONFINEMENT OPERATION IN A COLD CLIMATE,**
Department of Agriculture, Ottawa (Ontario). Engineering Research Service.
J. E. Turnbull, F. R. Hore, and M. Feldman.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 39-43, 2 fig., 6 tab., 4 ref.

Descriptors: *Farm wastes, Water pollution, Confinement pens, Odor, Cattle, Liquid waste, Air pollution, Water reuse.
Identifiers: Sluice-gate recirculation system, Plow-cover injector system.

A full-scale liquid manure system is described for the confined housing of approximately 800 dairy cattle, 1,500 sheep, and 40,000 poultry situated on a 2,800 acre animal research site adjacent to suburban housing near the city of Ottawa. The system is based on the established practice of recycling animal wastes to cropland. Through design, planning and management, the system comes very close to meeting presently accepted criteria for the control of water, air and soil pollution. The system contains a total of six-months storage capacity to avoid the potential for water pollution from winter land application of manure. Waste removal from trench storage in cattle and sheep barns is assured by use of the European hydraulic flushing system, and conventional scraping is used for poultry. Manure is held in storage under quiescent, low odor conditions. When manure is agitated for removal from storage, some odor is produced at the building site and a nuisance potential is created. However, site planning makes this potential problem practically non-existent since adequate space separation between the barns and surrounding neighbors was provided. Enclosed tankers control odors during transport and by applying the principle of rapid soil cover of manure, a relatively odor-free method of land disposal is achieved. The development of an inexpensive hooded tanker outlet which directs manure downward in a four-foot wide swath allows a tractor and plow to straddle and cover the manure in several seconds. Manure application rates do not exceed presently accepted levels for soil pollution control. (Bundy-Iowa State)

### 0773-A2, C1, C2

**MEASUREMENT OF RUNOFF AND RUNOFF CARRIED WASTE FROM COMMERCIAL FEEDLOTS,**
South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
J. M. Madden, and J. N. Dornbush.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 44-47, 2 fig., 6 tab., 4 ref.

Descriptors: *Farm wastes, Feed lots, Runoff, Biochemical oxygen demand, Chemical oxygen demand, Phosphate, Cattle, *South Dakota, Path of pollutants.

The objectives were to (1) determine the quantity and quality of runoff from livestock feeding operations in South Dakota, (2) to relate the above information to hydrological and geological considerations in order to appraise the overall influence of this runoff on specific beneficial uses of receiving water, (3) determine the influence of spring runoff as it occurs in northern climates, and (4) determine the pollutional characteristics attributable to the suspended matter in the feedlot runoff in order to extrapolate the effectiveness of proposed lagooning methods of treatment. Measurements have been made on four commercial sized feedlots for two years and an additional two lots for one year. Runoff has been quantified and composite and grab samples have been analyzed to determine the BOD, COD, dissolved and suspended solids, nitrogen forms, and phosphate content. The results have been used in the development of feedlot regulations and engineering standards for the control of feedlot runoff. Suggestions are also being made as to the type of treatment and management practice which will reduce the pollution potential. (Bundy-Iowa State)

### 0774-A2, A4, B2, C2, C3, E2

**MANAGEMENT OF BARNLOT RUNOFF TO IMPROVE DOWNSTREAM WATER QUALITY,**
Ohio Agricultural Research and Development Center. Wooster.
W. M. Edwards, F. W. Chichester, and L. L. Harrold.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 48-50, 5 fig., 8 ref.

Descriptors: *Farm wastes, Sprinkler irrigation, Runoff, Chemical analyses, Biochemical oxygen demand, Nitrogen, Phosphorus, Water quality.
Identifiers: *Biological analyses.

Quality of runoff from a small sloping barnlot is related to that of the larger farmland watershed of which the barnlot is a 0.005 part. Livestock waste was allowed to enter the stream system for a two year period, during which time the rate, volume, and quality of runoff was measured at the barnlot and downstream site. During the third year, barnlot runoff was diverted into a temporary storage pit and subsequently distributed through a sprinkler system onto nearby pasture land. Under these conditons no effluent from the barnlot was allowed to enter the stream system. Continued hydrologic and quality evaluations defined the effect of the barnlot runoff disposal system on downstream water quality. Chemical and biological analyses of runoff samples were made to relate water quality to hydrologic performance. BOD values for barnlot samples ranged from 10 to 420 mg/l as compared to <1 to 40 mg/l for stream samples taken at the watershed outlet. Concentrations of nutrients (mg/l) in the liquid phase of the barnlot runoff ranged from 10 to 70 total N, <1 to 15 NO3 (-)-N, <1 to 30 NH4 (+)-N, 5 to 60 organic N, and 1 to 10 P. Concentrations associated with the 0.1 to 1.5% w/v solid material separated from the runoff samples were <1 to 150 ppm NO3 (-)-N, 100 to 2,000 ppm NH4 (+)-N, 10,000 to 40,000 ppm organic N, and 300 to 1,200 ppm P. (Bundy-Iowa State)

### 0775-A2, A3, A4, B1, C1, C2, C3

**TRANSPORT OF POLLUTANTS FROM SLOPING CATTLE FEEDLOTS AS AFFECTED BY RAINFALL INTENSITY, DURATION, AND RECURRANCE.**
Agricultural Research Service, Lincoln, Nebr. Soil and Water Conservation Research Div.
N. P. Swanson, L. N. Mielke, J. C. Lorimor, T. M. McCalla, and J. R. Ellis.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 51-55, 4 fig., 4 tab., 9 ref.

Descriptors: *Farm wastes, Feed lots, Runoff, Cattle, Microorganisms, Rainfall, Nitrogen, Phosphorus, E. Coli, Bacteria, Fungi, Coliform, Crops, Path of pollutants, *Central U.S.
Identifiers: Rainfall simulator.

The pollution of surface waters by cattle feedlot runoff is of serious concern in the midwestern United States. Pollutants are transported in solution, in suspension, and as bedloads by feedlot runoff. The pollutants may be chemicals, microorganisms, organic materials, and soil sediments. Research on a feedlot instrumented for continuing runoff measurement and sampling, and research using a rainfall simulator on runoff plots on 8- and 13-percent slopes in another feedlot indicate that the pollution potential is not a direct function of only the yield of runoff. In one experiment on an 8-percent slope, a simulated rain of 2.8 inches per hour provided runoff with initial rates of loss per acre per hour of 4680 lbs. of total solids, 1160 lbs. volatile solids, 11.6 lbs. phosphorus, and 66.9 lbs. of organic nitrogen. Both the chemical contents of runoff (conductivity, total N, NH4N, NO3N, and COD) and the volume of solids decreased with continuing runoff. Runoff samples contained appreciable numbers of E. coli, Enterococci, total bacteria, fungi, bacilli, and clostridium. Higher intensities of rainfall provide added energy for increased detachment and transport of solids which adds to the pollution potential of each unit of runoff. The chemical content of feedlot runoff is compared with analyses of runoff from cropland recently published by other researchers in the midwestern United States. (Bundy-Iowa State)

### 0776-B1, B5, C2

**CHARACTERISTICS OF MANURE ACCUMULATIONS REMOVED FROM OUTDOOR, UNPAVED, BEEF CATTLE FEEDLOTS.**
Agricultural Engineer, Lincoln, Nebraska.
C. B. Gilbertson, T. M. McCalla, J. R. Ellis, and W. R. Woods.
Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19 - 22, 1971, p. 56 - 59, 6 fig., 4 tab., 8 ref,

Descriptors: *Farm wastes, Cattle, Feedlots, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen.
Identifiers: *Nebraska Field Laboratory, Unpaved feedlots.

Manure management is a necessary practice for beef feedlot operators unless area provided per animal is great enough to eliminate significant manure buildup on the feedlot surface. A study was initiated in 1968 to determine the effect of surface slope and cattle density on the quantity and quality of manure accumulation on outdoor beef feedlots. New feedlots with 3, 6, and 9% slopes were completed in July, 1968. Cattle were placed in each pair of lots at densities of 100 and 200 sq. ft. per head. Results have shown that considerable soil was mixed with accumulated manure by normal cattle movement within the lot. Dry matter removed from the lots averaged 2.3 times more for cattle densities of 100 sq. ft. per head than for lots with cattle densities of 200 sq. ft. per head. Feedlot slope appeared to have little effect on the amount of material removed. Approximately 30% of the total solids removed was volatile. BOD and COD values were highly variable. Further, each ton of dry matter removed contained 34 to 34 pounds of N. (Bundy-Iowa State).

### 0777-A6, A7, A10, A11, B2, B3, C2, D3, E2

**FEEDLOT MANURE MANAGEMENT IN A DESERT CLIMATE,**
California Univ., Davis. Dept. of Agricultural Engineering.
S. R. Morrison, G. P. Lofgreen, and T. E. Bond.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 60-61, 2 fig., 2 tab., 8 ref.

Descriptors: *Farm wastes, Odor, Dust, Nitrogen, Lagoon, Sludge disposal, Evaporation, Aerated lagoons, Sprinkler irrigation.
Identifiers: *Anaerobic lagoon, Imperial Valley (Calif).

Manure management problems are somewhat different in desert climates from those in regions with higher rainfall, and in some respects are less severe since runoff is not likely to cause stream pollution. More usual problems are impairment of human environment due to dust, odors, and flies; manure disposal without available cropland; and cattle performance impaired by muddy lots in winter and heat and dust in summer. To overcome these problems in the Imperial Valley of California a system using slatted floors, anaerobic pits, aeration lagoons, and a sludge disposal area is under investigation. Initial tests were done to determine the effect of loading rate on decomposition of organic matter and nitrogen, and the surface area required for evaporation of liquid wastes. Two 210-day tests have been completed using standard feedlot practices and animals on a 90 percent concentrate ration. Reduction of organic matter generally increased with decreasing loading rate, with about 70 per cent being lost at 0.023 lb/day/ft3. About 50 per cent of the nitrogen was removed at this loading rate. A surface area of 50 sq. ft. per animal was sufficient to evaporate the water from the waste. The cattle performed satisfactorily on the slatted floors, which had also functioned well in tests of a sprinkling system for heat-stress relief. (Bundy-Iowa State)

### 0778-A2, A8, B2, B3, C2, E2

**LAND DISPOSAL OF CATTLE FEEDLOT WASTES,**
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
H. L. Manges, L. A. Schmid, and L. S. Murphy.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 62-65, 4 fig., 1 tab., 4 ref.

Descriptors: *Farm wastes, Cattle, Feed lots, Runoff, Lagoon, Rainfall, Nitrogen, Phosphorus, Corn, Irrigation, Chemical oxygen demand, Crop response.
Identifiers: *Pratt Feed lot.

The objectives are 1) to characterize stormwater runoff from a feedlot, 2) to characterize manure generated in a feedlot, and 3) to determine the influence of different lagoon water and manure loadings on the soil, stormwater runoff from the disposal area, and corn yields. Analyses of runoff from rainfall have shown a COD of 4,000 to 10,000 mg/1, nitrogen of 100 to 800 ppm., phosphorus of 40 to 500 ppm. and total salts of 5,000 to 6,000 ppm. Analyses are being made to determine the concentration of other cations. Runoff from snowmelt has had a pollution load several times that from rainfall. During 1970, corn was grown on plots which received 0, 2, 4, 8, and 16 inches of lagoon water. Each plot was replicated 4 times and irrigated with well water as needed. Forage corn yields were measured. During 1970, corn also was grown on plots on which manure was plowed down at rates of 0, 10, 20, 40, 80, 160, and 320 tons per acre. Each plot was replicated four times and irrigated with well water. The manure was relatively high in nitrogen, calcium, iron and potassium with lesser amounts of magnesium, phosphorus, sodium and zinc. Plant population decreased as rate of manure application increased. Forage yields increased as rate of manure application increased up to 80 tons per acre. Above 80 tons manure per acre, corn yields were depressed.
(Bundy-Iowa State)

### 0779-A2, B2, B3, E1, F4

**EVALUATION OF BEEF FEEDLOT WASTE MANAGEMENT ALTERNATIVES,**
Oklahoma State Univ., Dept. of Agricultural Engineering. Stillwater.
A. F. Butchbaker, J. E. Garton, G. W. A.
Mahoney, and M. D.. Paine.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22 1971, p. 66-69, 6 fig., 2 tab., 6 ref.

Descriptors: *Farm wastes, *Pacific Northwest U.S., Waste treatment, Waste disposal, Cattle, *Feed lots, Confinement pens, Runoff, Design, Costs, *Design criteria, Southwest U.S., Central U.S., Computer programs.
Identifiers: Southern High Plains, Liquid flush system, Slotted floor.

The objectives were: (1) to develop beef feedlot design criteria to minimize pollution from runoff-carried wastes and to facilitate handling of solid and liquid animal wastes, and (2) to examine alternative beef feedlot waste disposal systems to obtain minimum cost systems for effective waste disposal. Waste handling systems for beef feeding operations were observed in the upper Midwest, Southern High Plains, desert Southwest, and Pacific Northwest. The systems studied included: slurry, solid, and runoff-carried waste handling systems. The ultimate disposal of the waste material was considered for each system. The design criteria developed represents the state of the art for most design considerations for confinement feeding facilities and open feedlot facilities. The results are presented in terms of flow diagrams and graphs comparing the various systems.
(Bundy-Iowa State)

### 0780-B1, B2, D3

**THE WASTE PATTERN OF BEEF CATTLE ON SLATTED FLOORS,**
Agricultural Research Service, St. Paul, Minn. Livestock Engineering and Farm Structures Research Branch.
R. O. Hegg, and R. E. Larson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971 p. 70-72, 2 fig., 4 tab., 8 ref.

Descriptors: *Farm wastes, Cattle, Confinement pens, Oxidation lagoons, Water pollution, Aerated lagoons, Path of pollutants.
Identifiers: *Slatted floors, High energy ration.

The distribution of wastes from beef cattle on a slatted floor with respect to the location of the feeding area and the watering area was determined. Seven trials were run to determine the waste pattern on a slatted floor over an oxidation ditch at the University of Minnesota Experiment Station at Rosemount, Minnesota. The first four trials (I-IV) were run with the self-feeder and waterer along the same side of the slatted floor area. Trials (V-VII) were run with a waterer against the wall opposite the self-feeder. Trials I through IV show that approximately 60% of the urine and 60% of the fecal matter were collected on the half of the floor that was nearest the feeder and the waterer. Moving the waterer to the opposite wall for trials V-VII changed the urine pattern such that 62% of the liquid was collected on that half of the floor nearest the new location of the waterer. The fecal pattern also changed but not to the extent that the urine pattern changed. The average daily collection of total dry solids ranged from 3.1 to 5.2 lbs/animal. The average total liquid collected each day ranged from 1.3 gallons to over 4 gallons/animal. The trials indicate that placing the waterers and feeders in one area of the confinement unit tends to concentrate the wastes in that area. (Bundy-Iowa State)

### 0781-B2, C2, D1, D2, D3, F1

**ANALYSIS OF DUCK FARM WASTE TREATMENT SYSTEMS,**
D. D. Schulte, and R. C. Loehr.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p. 73-76, 9 fig., 8 ref.

Descriptors: *Farm wastes, Model studies, Aerated lagoons, Phosphorus, Biochemical oxygen demand, Water consumption, Waste treatment, Ducks (Domestic), *Dynamic programming, Mathematical models.

In order to establish a rational basis upon which alternative duck farm waste water treatment systems could be evaluated, a mathematical model was developed. This model provided a structure in which the effect of the following items on the total annual cost of wastewater treatment could be considered: (a) capital costs of land and equipment; (b) interest and amortization rates; (c) operating costs of equipment and chemical costs; (d) treatment requirements for BOD, phosphorus, and suspended solids; (e) treatment system design; and (f) operational decisions such as water use rate and duck population. The efficiencies of three treatment alternatives, (plain sedimentation, chemical precipitation, and aerated lagoons), were established through bench scale tests and from mathematical equations and published information. Application of this model to a particular duck farm demonstrated the feasibility of using analytical models for agricultural waste management. Information available from this kind of approach provides a sounder basis for decision making. The results of this project, which was completed in June of 1970, will be used as an example of how mathematical models can be applied to problems of agricultural waste management.
(Bundy-Iowa State)

### 0782-A4, A8, B2, C2, D3, E2

**MULTISTAGE LAGOON SYSTEMS FOR TREATMENT OF DAIRY FARM WASTE,**
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
R. A. Nordstedt, L. B. Baldwin, and C. C.
Hortenstine.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 77-80, 7 tab., 8 ref.

Descriptors: *Farm wastes, *Sprinkler irrigation, Lagoons, Cattle, Biochemical oxygen demand, Groundwater, Water pollution, Aerobic lagoons, Nitrogen.
Identifiers: *Dairy, Multistage lagoons, Anaerobic lagoons.

The objectives are to (1) determine the design and operational parameters for treatment of dairy farm waste by multistage lagoon systems in areas with warm climates, sandy soils and high water tables, (2) determine the groundwater pollution potential from this type of system and any necessary corrective measures, and (3) determine the effects of the effluent from this type of system on a seepage irrigated pasture. A multistage lagoon system has been designed and constructed on a 600-cow dairy farm. The system consists of one anaerobic and two aerobic lagoons in a series arrangement. The efflent from the third lagoon flows by gravity into a 40macre seepage irrigation system in permanent pasture. Influent and effluent of each lagoon is sampled in two week intervals. Test wells are located at 15, 50 and 100 foot intervals from the anaerobic lagoon and at 15 and 100 foot intervals from the second lagoon. Water is drawn from 30 sampling tubes in the seepage irrigated pasture at three week intervals. Results from the first five months of operation indicate an average influent BOD of 543 mg/l. at a flow of approximately 60,000 gallons per day. BOD reductions of 89%, 54% and 8% in the first, second and third lagoons, respectively, have been achieved for a total reduction of 95%. (Bundy-Iowa State)

### 0783-A4, A6, A7, A10, B3 D1, E2

**SOLVING THE POULTRY MANURE PROBLEM ECONOMICALLY THROUGH DEHYDRATION,**
Pennsylvania State Univ., University Park. Dept. of Poultry Science.
G. O. Bressler, and E. L. Bergman.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 81-84, 3.fig., 5 tab.

Descriptors: *Farm wastes, Anaerobic conditons, Odor, Drying, Poultry, Bacteria, Economics, Dehydration, Air pollution, Water pollution.
Identifiers: *Heater dryer, High velocity air, Time clock, Two-stage system.

Poultry manure handling is a two-pronged problem, high moisture content and anaerobic bacterial activity causing obnoxious odors. The objectives were 1) to remove as much moisture as possible from the poultry manure inside the poultry house to lessen the weight of the material to be handled; 2) to eliminate odors and flies; and, 3) to develop an automatic system of manure handling to eliminate manual labor. A two-stage drying system achieving these objectives has been developed. Stage 1 drying occurs inside the poultry house by application of high velocity air to the manure and stirring the manure frequently. In this stage manure is dried to about 30% moisture, which is 1/3 of the original weight and it is relatively free of obnoxious odors because odor producing bacteria are destroyed. Movement of air at high velocity (500 feet per minute) is accomplished by operating continuously 20-inch fans spaced about 35 to 40 feet apart lengthwise to the manure bays or pits inside the poultry house. Stirring is accomplished with a specially designed rake and cleaning device which turns, churns, tumbles, and mixes the poultry droppings as they fall to the floor underneath the birds. The dry, powdery product is free of obnoxious odors, has shelf life, and is in a form acceptable for merchandising as an organic fertilizer. Income now being received for this product exceeds the costs of Stage 1 and 2 drying methods. (Bundy-Iowa State)

### 0784-A8, B2, B4, E2

**A FARM SCALE DAIRY WASTE DISPOSAL SYSTEM,**
Washington State Univ., Pullman.
D. O. Turner, and D. E. Proctor.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 85-88, 4 fig., 4 tab., 6 ref.

Descriptors: *Farm wastes, Cattle, Sprinkler irrigation, Confinement pens, Lagoons, Nitrogen, Rotations, Waste disposal, Waste storage, Crop response, Washington.
Identifiers: *Large annual rainfall, Plastic irrigation pipe.

Livestock wastes from beef feed lots and from the dairy cattle industry are produced in large quantities in small areas. A systems approach to waste disposal has been developed by Washington State University in conjunction with the Washington State Department of Institutions' Honor Farm at Monroe. This system uses a covered confinement area to exclude excessive rainfall; a collection and transfer system to move wastes from confinement areas to storage lagoons; and pipeline and sprinkler systems to move wastes from confinement areas or lagoons to areas of ultimate disposal by field application. Animal waste from a herd of 250 mature Holsteins is scraped, flushed, and transported with minimum water into two 1,000,000-gallon capacity lagoons where it is held in winter storage for field distribution during the growing season. The organic degradation and nutrient recycling capability of soil as a receiver of wastes, coupled with seasonal application, appears to be the key to such waste disposal. Loading levels are being defined under field conditions. Crops under study are silage corn, cereal rye for greenchop, and grass legume pastures, as these crops complement dairy operations and tend to recycle nitrogen. Measurements are being taken of distribution patterns by the sprinklers, infiltration rates, bacteria survival, nitrate-nitrogen concentrations in the forage and through the soil profile to a 4-foot depth, BOD counts, botanical composition of forage stands, and crop yields.
(Bundy-Iowa State)

### 0785-B2, B3, D2, D3, E3

**A TOTAL BIOCHEMICAL RECYCLE PROCESS FOR CATTLE WASTES,**
Babson Bros. Co., Elmhurst, Ill. Environmental Div.
L. G. Carlson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 89-91. 3 fig, 5 ref.

Descriptors: *Farm wastes, Cattle, Liquid wastes, Phosphates. Proteins, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Potassium, Microorganisms.
Identifiers: *Babson Biochemical Process, Reaction tower.

The Babson Biochemical Process accepts cattle wastes, such as liquid manure, and recovers undigested solids, as washed and cleaned particulate matter, from a counter-current classification tower. The solids are pelletized into slugs two inches in diameter and one-half inch thick. The remaining liquid, consisting of suspended solids, dissolved solids, and some colloidal matter, is pumped to a Reaction Tower, Reaction Vessel, and Enzyme Vessel complex, wherein, bubbles are formed as a function of the rate of mass transfer, and is key to this biochemical process. The residence time is a few hours with partial recycle to keep enzymatic activity high. Recovery of activity is very rapid, even after several weeks in the endogeneous phase. The effluent is then sent to a flocculation/coagulation (F/C) system, where phosphates, proteins, polysaccharides, metal ions, etc. are removed, dried, and fortified to make a fertilizer which is slow to dissolve. The liquid effluent from the F/C vessels is then deionized and decolorized, and used for drinking water, or partially de-ionized, and used for corral flushing of manure into a common pit.
(Bundy-Iowa State)

### 0786-A4, B3, D2, D3, E3

**THE UK RECONCILIATION OF MODERN INTENSIVE LIVESTOCK FARMING WITH A BASICALLY URBAN SOCIETY,**
Agricultural Development and Advisory Service, London (England).
K. B. C. Jones.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 92-94. 5 tab, 6 ref.

Descriptors: *Farm wastes, *Animal populations, Confinement pens, Poultry, Cattle, Biochemical oxygen demand, Solid wastes, Phosphates, Nitrogen, Water pollution, Regulations.
Identifiers: Council on Environmental Quality, United Kingdom.

Intensive livestock production will continue to be centered on those parts of the UK where the soils and climate are most favorable and where workers have the technical skills, and management the financial and marketing abilities to succeed. It is most likely that as now, these units will be in lowland areas near big centers of population. Wherever possible, correlation will be maintained between size of livestock unit kept and area available for manure spreading. In time, the law may make this concept on obligation. Planning permission for non-agricultural development may be refused if it is too near an existing livestock unit. Zoning may be more widespread. New developments already require the interests of vets, neighbors, planning authority, river authority and public health inspector to be met. These interests are achieving a better understanding of the farmer:s needs and of each other:s points of view. (Bundy-Iowa States)

### 0787-A6, B1, C1, C2, E1, E2

**IDENTIFICATION OF CARBONYL COMPOUNDS IN A SWINE-BUILDING ATMOSPHERE,**
Iowa State Univ., Ames.
L. D. Hartung, E. G. Hammond, and J. R. Miner.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 105-106. 1 tab, 10 ref.

Descriptors: *Farm wastes, Atmosphere, Odor, Swine, Organic compounds, Air pollution, Land management.
Identifiers: Carbonyl-free air, Sutton's equation, *Carbonyls.

Prior studies of swine-building atmospheres have identified amines, carbonyls and sulfur compounds in these gases. More detailed identification work is being done to determine which compounds of these three classes are responsible for odor. This information should be valuable for eventual odor-control technology. Carbonyls can be determined readily as the 2,4-dinitrophenyl-hydrazine (2,4-DNPH) derivatives. A measured quantity of swine-house gas was pulled through a reaction column composed of a solution of 2,4-DNPH (in 2.5M H2SO4) on celite. The 2,4-DNPH derivatives were eluted from the column with hexane at the end of the run. Tentative identification was by thin layer chromatography (tlc), which allowed quantitative measurement of those compounds present in largest concentrations. In these cases, the derivative was leached from the tlc material, diluted to a measured volume, and the ultraviolet absorption max was measured. Carbonyls identified to date and their concentrations when measurable are: acetone (125 ppb by volume), ethanal, butanal, methyl ethyl ketone (53 ppb), pentanal, nonanal. (Bundy- Iowa State)

### 0788-A4, A5, A6, B1, B4, F2

**IMPACT OF FARM ANIMAL PRODUCTION**

**AND PROCESSING ON THE TOTAL ENVIRONMENT,**
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. P. Taiganides, and R. L. Stroshine.
In: Livestock Waste Managment and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 95-98. 1 fig, 7 tab, 13 ref.

Descriptors: *Farm wastes, Biochemical oxygen demand, Chemical oxygen demand, Odor, Waste water (Pollution), *Environmental effects.
Identifiers: *Animal waste impact, Odor nuisance, Soil oxygen demand.

A long-term study under the auspices of the Agricultural Pollution Control Research Laboratory at Ohio State University will attempt to delineate the full impact of the world farm animal industry, from birth to the point of consumption, ultimate use, or death by decay, on the quality of the natural environment. The impact from the production of animals on USA farms was determined by using animal population figures from the 1969 U.S. Agricultural Statistics. Depending on the geographic region, various assumptions were made as to the amounts of manure which could reasonably be expected to be discharged into natural water bodies or disposed on land or into air resources. Assumptions on percentage of animals in total confinement, pasture or partial confinement were made to facilitate estimates of water runoff and land disposal. Odor nuisance could only be evaluated in qualitative terms by making assumptions on the extent of urbanization at each of the six geographic regions. A quantitative value for the impact of by-products and wastes from animal industries on the natural environment was obtained using BOD, COD, fertility nutrients, volatile solids, SOD (Soil Oxygen Demand) and physical quantities. An attempt was made to compare these values with values from other basic industries, such as car manufacturing and some chemical industries. (Bundy- Iowa State)

### 0789-A1, A2, F2

**LITIGATION EXPERIENCES OF FIVE LIVESTOCK AND POULTRY PRODUCERS,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
T. L. Willrich, and J. R. Miner.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 99-101. 7 ref.

Descriptors: *Farm wastes, Odor, *Legal aspects, Water pollution, Swine, Cattle, Poultry, Missouri, Iowa, Judicial decisions.
Identifiers: *Law suits, Odor nuisance.

Several livestock and poultry producers have faced law suits from neighboring residents based upon complaints of odor and water pollution. Such public and private nuisance suits demand that producers consider the possible effects of their site selection and waste management practices upon neighbors. Cases concerning three beef producers, two swine producers and a poultry growing operation are considered in detail. The physical features of the systems are described, as well as the operation of the facilities. Both swine producers were utilizing confinement facilities with manure storage facilities beneath partially-slotted floors. In the Missouri case, both localized water pollution and odors were found to have caused damages to two nearby rural neighbors. Substantial punitive damages were awarded. The case in Iowa involved odors and their influence on neighbors located approximately 300 feet north of the operation. The first hearing of the case resulted in a hung jury. The poultry operation was in north-central Iowa, about 900 feet southeast of a farm home. The neighbors sought both damages and injuctive relief due to odors. (Bundy-Iowa State)

### 0790-A6, A7, F6

**ORIGINS AND IMPLICATIONS OF ENVIRONMENTAL QUALITY STANDARDS FOR ANIMAL PRODUCTION FIRMS,**
Economic Research Service, Washington, D.C. Farm Production Economics Div.
J. B. Johnson, and L. J. Connor.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 102-104. 14 ref.

Descriptors: *Farm wastes, Feed lots, Runoff, Cattle, *Legal aspects, Water pollution control, Federal Government, Local Governments, State Governments, Control, Standards, Regulation.
Identifiers: *Feed lot firms, Nebraska Pollution Control Council.

The alternative measures of minimizing pollution from animal wastes can be categorized as (1) voluntary control measures adopted by animal producers, (2) individual legal actions, and (3) statutes and regulations established by local, State, and Federal Governments. Some individual producers and producer groups have adopted abatement technologies and taken other more drastic measures such as shifting the geographic location of their operations to minimize the pollution potential of their animal production operations. Certain animal production firms have been defendants in legal litigations by plaintiffs seeking to induce changes in the producers' animal production activities. Animal production firms are subject to different forms of private legal litigation, those being (a) trespass, (b) nuisance, (c) negligence, and (d) strict liability. Several local, State, and Federal Government agencies have existing statutes related to the management of animal wastes. Governmental statutes have generally implemented controls on animal production firms by (a) direct regulations such as licenses and registry requirements, (b) payments for installation of particular pollution control devices or lower rates of property tax, and (c) by charges such as fines or excise taxes for discharging excessive amounts of animal pollutants. (Bundy- Iowa State)

### 0791-A6, A7, D2, E2, F6

**METEOROLOGICAL CONTROL OF MALODORS FROM LAND SPREADING OF LIVESTOCK WASTES,**
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
R. A. Nordstedt, and E. P. Taiganides.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 107-109, 9 ref, 1 fig.

Descriptors: *Farm wastes, Odors, Meteorology, Air pollution, Model studies, Control, Waste disposal.
Identifiers: Land spreading, Odor nuisance.

One of the foremost problems in land disposal of livestock wastes is the emission of malodorous gases from these wastes and their transport into populated areas through the atmosphere. Therefore, malodors are a constraint on land spreading of livestock wastes. Chemical treatment of these wastes for abatement of malodors is usually quite expensive. The applicability of meteorological control to land spreading of livestock wastes, and the development of an air quality model to predict the odor nuisance potential from land spreading operations were investigated. Simulations with the air quality model have shown that meteorological control of malodors from land spreading of livestock wastes is possible. The model is limited by the need for data on emission rates of malodorous gases from various livestock wastes as well as the properties of these gases. Better dispersal equations and experimental determination of diffusion parameters will also assist in applying the model to field conditions.
(Bundy-Iowa State)

### 0792-A6, D2, F6

**CHROMATOGRAPHIC IDENTIFICATION OF MALODODORS FROM DAIRY ANIMAL WASTE,**
Ohio State Univ., Dept. of Agricultural Engineering. Columbus.
R. K. White, E. P. Taiganides, and G. D. Cole.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 110-113, 5 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Chromatography, Analytical techniques, Odor, Hydrogen ion concentration, Aeration, Sulfur, Organic compounds, Cattle.
Identifiers: *Anaerobic dairy wastes.

Recent trends toward large, confined animal production units and the urban encroachment into agricultural areas have brought into focus the problem of odor nuisance from animal waste. There is a need for identifying satisfactory methods of controlling and abating the odor nuisance from animal waste. Before control techniques can be developed, an analysis of the odors and an understanding of the physical, chemical and biological conditions that help generate them is needed. The objectives of this study were: to separate and identify principal odorous compounds emanating from dairy animal wastes and to measure the effect of aeration on the production of principal odors from dairy animal wastes. Eight odorous compounds were tentatively identified by comparing Kovat Indexes for the principal odorous fractions separated by the gas chromatograph and the Kovat Indexes of known compounds. Also, an organoleptic evaluation of the odors was employed. The compounds tentatively identified using the column selected for hydrocarbons and sulfur compounds were hydrogen sulfide, methanethiol, methyl sulfide, diethyl sulfide, propyl acetate and n-butyl acetate. The amine compounds detected were trimethylamine and ethylamine. Aeration eliminated or diminished the production of the principal odors identified. (Bundy-Iowa State)

### 0793-A6, A7, A13, B1, C2, D1

**CONTROL OF ODORS FROM POULTRY HOUSES,**
Agricultural Research Service, Beltsville, Md. Livestock Engineering and Farm Structures Research Branch.
G. B. Willson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 114-116, 2 fig, 1 tab, 4 ref.

Descriptors: *Farm wastes, Odors, Dusts, Poultry, Filters, Ammonia, Control, Air pollution.
Identifiers: Water spray system, Pad-type filter, Dry filters, Burlap.

Odor and, to a lesser extent, the dust in ventilation air exhausted from poultry houses constitute an aesthetic nuisance. Use of filters and water spray chambers were evaluated for their effectiveness in removing the odor and dust. Three variations of baffle impingement filters with and without a water spray were tested. Dust removal efficiencies were determined by particle counts on filters through which a measured quantity of air had been drawn. Odor strength was evaluated organolepti-

cally. The baffle impingement filters reduced the odor although they only removed a negligible amount of dust. Introduction of a water spray ahead of the baffle improved the dust removal to around 50% and practically eliminated the odor. Control of odor and dust would enhance the desirability of poultry houses as neighbors. Use of the water spray baffle impingement filters should reduce air pollution complaints.
(Bundy-Iowa State)

### 0794-B2, C1, C2, F6

**AMMONIA DESORPTION FROM CONCENTRATED CHICKEN MANURE SLURRIES,**
Agricultural Research Service, Ithaca, N.Y. Agricultural Engineering Research Div.
A. G. Hashimoto, and D. C. Ludington.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 117-121, 3 fig, 5 tab, 7 ref.

Descriptors: *Farm wastes, *Nitrogen, *Ammonia, Poultry, Hydrogen ion concentration.
Identifiers: *Chicken manure, Fick's Second Law.

The purpose was to determine the parameters affecting ammonia desorption from concentrated chicken manure slurries and to develop an equation to predict the rate of ammonia desorption. Analyses of variance were performed to determine whether any correlation existed between the desorption rate constant and the fraction of undissociated ammonia, (Fu), temperature, air flow, total and volatile solids, initial organic nitrogen concentration and initial ammonia nitrogen concentration. Preliminary analysis indicates that only Fu and temperature have significant correlation with the desorption rate constant under the experimental agitation rates and geometric shape of the reaction vessel. The desorption rate constant may be predicted by an equation of the following form: K/l-Fu = A (T/l-Fu)B where: K= ammonia desorption rate constant (hour-1); T = temperature (deg. F); Fu = fraction of undissociated ammonia; A and B = constants. The amount of base required to maintain the desired pH was recorded to determine which pH range might be the most efficient in stripping ammonia. Below pH 10.0 there is a direct relationship between the ratio of base required to ammonia removed and pH. Above pH 10.0 the ratio is independent of pH.
(Bundy-Iowa State)

### 0795-A4, A12, B2, C3, F6

**ANTIBIOTIC RESISTANCE AND RESISTANCE TRANSFER BETWEEN BACTERIAL ISOLATES IN A WASTE LAGOON,**
North Dakota State Univ., Fargo. Dept. of Bacteriology.
M. Bromel, Y. N. Lee, and B. Baldwin.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 122-125, 2 fig, 6 tab, 11 ref.

Descriptors: *Farm wastes, Liquid wastes, Salmonella, Microorganisms, Cattle, E. coli, Public health, Pathogenic bacteria, Transfer.
Identifiers: *Public health hazard, R factors.

The incidence and pattern of antibiotic resistance in bacterial isolates from liquid and solid bovine wastes and from the Red River of the North were determined by disc assay and tube dilution methods. Subsequent in vitro mating experiments were performed between the enteric members of these two groups of isolates so that the patterns of antibiotic-resistance transfer could be elucidated. Levels of antibiotics present in waste lagoon water and river water were determined by microbiological assay. Complete resistance to aureomycin, terramycin sulfamethazine and sulfaethoxypyridazine was shown by isolates of the genera Salmonella, Proteus, Streptococcus and Escherichia. Developing antibiotic resistance was shown by isolates of the teneral Shigella and Klebsiella. Drug sensitivity was shown only by clostridial isolates. Successful transfer of multiple drug resistance to sulfamethazine, penicillin and strepromycin was obtained from a Proteus sp. to an Escherichia sp. Results from the matings of the recombinants with drug-sensitive typhoid and dysentry organisms are reported. In some instances, detectable levels of terramycin and aureomycin were found in waste waters. The possibility for drug resistance transfer between organisms in livestock wastes and pathogens in public waters was significantly high and constitutes a potential public health hazard. (Bundy-Iowa State)

### 0796-A2, A3, A4, C3

**DIFFERENTIATION OF RUMINANT FROM NON-RUMINANT FECAL SOURCES OF WATER POLLUTION BY USE OF ENTERIC BACTERIA,**
South Dakota State Univ., Brookings. Dept. of Bacteriology.
P. R. Middaugh, L. R. Koupal, R. L. Pierce, Jr., J. E. Tiede, and J. W. Zerfas.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 126-128, 1 fig, 35 ref.

Descriptors: *Farm wastes, Runoff, *Coliforms, Microorganisms, Bacteria, *Streptococcus, Nitrogen, Cattle, Sheep, Goats, Lagoons, Pollutant identification.
Identifiers: *S. bovis, Fecal pollution.

Studies on methods for improving the land disposal of animal wastes or on methods to minimize storm run-off waste pollution of streams or lakes would be aided if feed lot wastes in water could be differentiated from non-ruminant or human waste sources. A laboratory study was based on the presence of a fecal streptococcus, Streptococcus bovis, in feces of ruminant farm animals, cattle, sheep and goats which have from 1 to 20 million cells per ml. of rumen fluid. In a preliminary survey of fecal streptococci occurring in lakes and rivers and in municipal wastes and a dairy lagoon the predominant organism was Streptococcus faecalis and its varieties which represented 90% of the fecal streptococci. S. bovis constituted only 3% of the streptococci. The standard media used to cultivate gut bacteria were highly inhibitory for S. bovis cells which were added to water samples. An improved medium with reduced sodium azide, 0.02%, improved anaerobic culture conditions and the quantitative collection of the bacteria on membrane filters led to a selective method using a starch hydrolysis overlay. The improved medium quantitatively detected S. bovis bacteria added to river water samples and allowed their routine isolation. Of the isolates, 92% were found to be Streptococcus bovis and 8% were S. faecalis variety liquefaciens. To be an effective pollution indicator, S. bovis must survive sufficiently to be readily detected.
(Bundy-Iowa State)

### 0797-A11, B3, C3, D2, E3

**GROWTH KINETICS OF RUMEN BACTERIA IN SOLUTIONS OF POULTRY EXCRETA,**
Kentucky Univ., Lexington.
H. E. Hamilton, I. J. Ross, J. J. Begin, and S. W. Jackson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 129-131, 8 fig, 12 ref.

Descriptors: *Farm wastes, Poultry, Feeds, Hydrogen ion concentration, Microorganisms, Growth rates, Cattle.

Poultry excreta contains nutrients that can be utilized as a livestock feed. Successful feeding trials with untreated litter have proven the feasibility of utilizing excreta as a feedstuff. Excreta from hens fed a drug-free diet was blended and diluted with water, sterilized, and placed in a fermentor equipped with an indirectly driven agitator, automatic pH controller, temperature controller, foam controller, and sampling device. The solution was then inoculated with rumen fluid from a steer being maintained on a diet containing sterilized chicken manure and fermented anaerobically for 48 hours. Samples were taken as the fermentation process progressed and diluted and plated for microflora counts. The colonies in the inoculated tubes were counted after 7 days of incubation. There was logarithmic growth beginning about three hours after inoculation and subsiding about ten hours after inoculation. High solids levels decreased the maximum population and increasing and/or decreasing the pH from that in the rumen altered the maximum population.
(Bundy-Iowa State)

### 0798-A4, A5, A6, A8, B2, B3, C2, D1

**THE ROLE OF MICROORGANISMS IN THE MANAGEMENT OF ANIMAL WASTES ON BEEF CATTLE FEEDLOTS,**
Agricultural Research Services, Lincoln, Nebraska.
T. M. McCalla, and L. F. Elliott.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 132-134, 2 fig, 3 tab, 28 ref.

Descriptors: *Farm wastes, Cattle, Feed lots, Microorganisms, Pathogenic bacteria, Nitrogen, Crops, Odors.

Animal wastes on feedlots may leave the feedlot by mechanical removal, runoff, percolation through the soil profile, volatilization, or decomposition. Of these mechanisms, microbial decomposition plays a major role in the rate and route of manure loss. Laboratory and feedlot studies, at Lincoln and Central City, Nebraska, indicate mechanical removal of manure from the feedlot may be necessary only after several years of accumulation. The manure in the feedlot can be mounded to provide a protected drained area for the animals, and the manure serves as a compost pile to aid in decomposition. The feedlot studied is level with a high water table and limited runoff occurs. Laboratory studies have indicated as much as 90% of the nitrogen and 50% of the carbon in the manure and urine can be lost by decomposition in a 4-month period. Soil microorganisms can be managed to reduce odors and to dispose of animal wastes without pollution of surface or ground waters. If the surface of the feedlot is aerobic, many odor-causing compounds can be metabolized before they reach the atmosphere. It may also be desirable to maintain aerobic conditions at the feedlot surface for sanitary reasons. Laboratory studies conducted at Lincoln showed Salmonella sp. added to beef manure died rapidly under aerobic conditions but survived under anaerobic conditions. Feedlot soil atmosphere studies found high concentrations of $CH_4$ and $CO_2$.
(Bundy-Iowa State)

### 0799-B2, D1

**AGITATION IN LIQUID MANURE TANKS,**
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
J. I. Sewell.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 135-137, 4 fig, 1 tab, 5 ref.

Descriptors: *Farm wastes, Model studies, Liquid wastes, Pumps, Slurries, Design, On-site tests, Cattle, Mixing.

Few problems with agitation were encountered in two full-scale field tests of liquid manure systems at dairies. Adding water to the tanks immediately after emptying greatly facilitated agitation. As the quantity of waste hay, silage, and green chop entering the pits increased, agitation became more difficult. Scraping manure into the tanks before appreciable drying had occurred also facilitated agitation. Minimizing the entry of twine, wood chips, and coarse hay into the pits reduced downtime. While the results of the model studies suggested that best agitation could be achieved in pits equipped with side and center baffles, effective agitation was achieved in pits constructed with cover support columns and without baffles. As the model studies suggested, cover support columns did not adversely affect agitation. In designing liquid manure pits where agitation difficulties are expected, center and side baffles should be considered. (Bundy-Iowa State)

### 0800-B1, B2

**MEASURING METHOD FOR EVALUATING THE ABILITY TO PUMP SEMI-LIQUID AND MANURE,**
Bayerische Landesanstalt ue Landtechnik, Weihenstephan (West Germany).
K. Grimm, and G. Langenegger.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 138-141, 145, 9 fig, 10 ref.

Descriptors: *Farm wastes, Liquid wastes, Pump testing, Measurement, Pumps.
Identifiers: Consistency factor, Manure pump, Manure consistency.

A large number of pumps are on the market; some are very well adapted to pumping liquid manure and some lack several things which one could wish for. A technical measurement for the capacity of individual pumps to boost liquid manure is necessary in order to put the individual pumps to work at the correct place and to be able to plan liquid manure installations. Tests haves shown that all semiliquid and liquid manure mixtures may be evaluated in a relatively simple way insofar as the ability to be pumped is concerned. Measuring manure consistency by the ball method is described. This method of measuring provides a uniform prerequisite for testing pumps and thereby makes an exact examination possible with varied semi-liquid manure mixtures with different consistencies. (Bundy-Iowa State)

### 0801-B2, B4, C2, C3, E2

**PUMPING CHARACTERISTICS, BIOLOGICAL AND CHEMICAL PROPERTIES OF DAIRY MANURE SLURRIES,**
British Columbia Univ., Vancouver. Dept. of Agricultural Engineering.
L. M. Staley, N. R. Bulley, and T. A. Windt.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 142-145, 6 fig, 2 tab.

Descriptors: *Farm wastes, Cattle, Irrigation, Biochemical oxygen demand, Hydrogen ion concentration, Potassium, Sodium, Chloride, Ammonium, Sprinkler irrigation, Waste disposal, Design pumps.
Identifiers: *Dairy, Piping losses.

A manure handling system has been designed to permit a zero grazing management practice and utilize above ground storage and sprinkler irrigation methods of waste disposal. Manure from the exercise yard and holding area is scraped into a 288 cubic foot below grade sump. From this point the complete system is operated by a 30 HP electric motor and Holz helical type manure pump. The pump is used for filling the 100,000 US gallon above ground storage tank; for agitation and mixing within the tank and returning the slurry to the sump for dilution if necessary, before pumping through a 4 inch diameter aluminum irrigation system to a standard No. 104 Rainbird sprinkler. BOD, COD, pH, ammonia, organic and nitrate nitrogen, total and ortho phosphate, sodium, potassium, chloride, total volatile and suspended solids were determined at bi-weekly intervals for (1) water inputs, (2) manure into and out of storage and (3) water outflows from field drains. Sampling began June 2, 1970 and will continue throughout the winter season. (Bundy- Iowa State)

### 0802-A6, A7, B2, B3, B4, C2, D1, D3, E2, E3

**AUTOMATED HANDLING, TREATMENT AND RECYCLING OF WASTE WATER FROM AN ANIMAL CONFINEMENT PRODUCTION UNIT,**
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. P. Taiganides, and R. K. White.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 146-148, 4 fig, 3 ref.

Descriptors: *Farm wastes, Confinement pens, Oxidation, Odors, Dusts, Aerobic treatment, Biological oxygen demand, Waste water treatment, Water reuse, Hogs.
Identifiers: *Automatic flushing, Flushing tanks, Solids separator, Fuch's oxygenator.

Manure is flushed out by flooding the gutters of a confinement building where 500 pigs are raised from 20 to 220 lbs. This way no labor is needed to scrape the manure out plus no offensive odors are released into the building because of frequent flushing. The flushed wastewater is pumped onto a screen which separates the solids from the liquid. The solids are aerobically digested, deodorized and stored before final disposal onto agriculturally productive land. The liquids separated at the screen are discharged into an oxidation ditch. Ditch effluent is clarified and the supernatant is pumped back into the building as flushing water. Provisions to disinfect the recycled water for odor and disease control are present in the system. Laboratory-scale model was tested to arrive at maximum loading rates for odor control. Four loading rates ranging from 30-80 lbs VS/1000 ft/day were tested. Preliminary results show that hourly loading is better than daily slug loading. All loading rates can be effective, but the higher rates require closer supervision. Odors given off are ammonia-like at first but change to earthy or musky inoffensive odors after the 6th day. Foaming was much greater with slug loading. However, the settling characteristics of the slug-load unit were better than hourly-loading. (Bundy-Iowa State)

### 0803-B2, C2, D1, D3, E3

**MANURE MANAGEMENT IN A 700-HEAD SWINE-FINISHING BUILDING; TWO APPROACHES USING RENOVATED WASTE WATER,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. J. Smith, T. E. Hazen, and J. R. Miner.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 18-22, 1971, p 149-153, 7 fig, 2 tab, 14 ref.

Descriptors: *Farm waste, Confinement pens, Swine, Chemical oxygen demand, Settling, basin, Oxidation treatment, Sludge, Water reuse.
Identifiers: *Flushing gutter, Anaerobic lagoon.

Iowa State University had used fresh water for flushing manure from a confinement building but difficulties in effluent disposal stopped this practice. Two systems of waste water renovation were examined. Preliminary studies showed that adequate manure removal and reduced water use could be obtained by intermittent discharge of a tank of cleaning water. Mechanisms for controlling such discharge are described. The presence of an open flushing gutter in the pen area was found to affect defecation habits very favorably, also the action of the pigs' feet improved manure transport. The effect on the pigs of exposing them to their renovated effluent was unknown; hence, the first scheme included an anaerobic lagoon followed by an oxidation ditch, both external to the building. Total sludge return to the oxidation ditch was used by incorporating a settling tank. Conventional sanitary engineering measurements were made at various points in the cycle; these included oxygen demand, solids, various inorganic ions and a membrane filter count of coliform density. Tests were started in January 1969, and it was found that a stable, odorless effluent of less than 150 mg/l BOD5 could easily be obtained, even at low ditch temperatures. (Bundy-Iowa State)

### 0804-B2

**IMPROVING WATER UTILIZATION EFFICIENCY IN AUTOMATIC HYDRAULIC WASTE REMOVAL,**
Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.
E. E. Jones, G. B. Willson, and W. F. Schwiesow.
In: Livestock Waste Management and Pollution Abatement, Proceedings, International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 154-158, 11 fig, 8 ref.

Descriptors: *Farm wastes, Velocity, Automation, Hogs, Water utilization.
Identifiers: *Automatic hydraulic waste removal, Flush tank.

One of the goals of the USDA Farmstead Water Systems Research is to improve water utilization efficiency in livestock sanitation. Reports of large volumes of water being used to remove solids from under slotted floors led to theoretical and model studies of automatic hydraulic waste removal in 1963. In 1966 certain principles developed from these studies were incorporated in a partically slotted floor swine building. A maximum design flush volume of 3 gallons per pig (300 gallons) was used. Movie film analysis of waste removal revealed that as much as 90% of the water was discharged clear at the end of the gutter. Reducing flush volume to 160 gallons resulted in incomplete waste removal. Major factors limiting water utilization efficiency have been identified and verified in design modifications. Unsteady flow conditions and the modification of fluid properties by dissolved and suspended solids result in velocities about 30% higher than predicted by Manning's formula. Above velocities of 3 fps the relationships between waste deposition, depth of flow and duration of flow determine water utilization efficiency. Automatic hydraulic waste removal by making possible daily or more frequent waste removal will provide a batter livestock environment at less cost. (Bundy-Iowa State)

### 0805-A8, B3, B4, C1, C2, D3, E3

**HIGH RATE POULTRY MANURE COMPOSTING WITH SAWDUST,**
North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
W. S. Galler, and C. B. Davey.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 159-162, 9 fig, 2 tab, 2 ref.

Descriptors: *Farm wastes, Poultry, Aerobic treatment, Carbon, Nitrogen, Grains, Cation exchange, Crop response, Waste treatment.
Identifiers: *Composting, Sawdust.

The feasibility of high rate, thermophilic composting of animal wastes mixed with carbonaceous materials and the affect of the compost on plant growth were investigated. Poultry manure and sawdust were initially selected in order to get the proper moisture content and carbon to nitrogen ratio (C:N). Each batch was characterized chemically in order to determine the moisture content, the proper C:N and available phosphorus, potassium, calcium, and magnesium. Sixteen batch studies were made using a 45 cubic foot rotating drum approximately two-thirds full. The composting mass was aerated continuously. The effects of aeration, agitation, C:N, and moisture content were studied. The pH, temperature, and oxygen uptake were studied for each run. Mass balances were made to determine nitrogen losses. Cellulose degradation was also studied. After removal from the composter, cellulose degradation took place as a fungus developed in the pile. The cellulose content decreased during the storage phase by over 25% in four to six weeks while the cation exchange capacity rose from 35 milli-equivalents per 100 grams to 67 milli-equivalents per 100 grams. Nitrogen losses for the properly run process averaged about 3.5%. The final product had a blackish-white color and an odor resembling a fresh humus soil. Greenhouse studies were made using tomatoes, wheat, millet and greenbeans. The plants were planted in soil compost mixture ranging from 0% to 100% compost by weight.
(Bundy-Iowa State)

### 0806-A6, B3, C1, D2, E3

**COMPOSTING DAIRY COW WASTES,**
Agricultural Research Service, Beltsville, Md. Livestock Engineering and Farm Structures Research Branch.
G. B. Willson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 163-165, 4 fig, 2 tab, 4 ref.

Descriptors: *Farm wastes, Aerobic treatment, Cattle, Hay, Silage, Grains, Odor, Waste treatment.
Identifiers: *Composting.

Composting is a biological process for the degradation of solid wastes. It has been used to reduce municipal wastes to an odorless, stable material that may be used as a soil conditioner. The compost may be easily handled or stored. Like other biological degradation processes, the process may be either aerobic or anaerobic or a combination. The aerobic process is faster and produces more heat, which maintains the elevated temperatures required. The aerobic process, which seems to have merit for treatment of farm animal wastes, was studied. Waste from the gutter of a stanchion barn was used. Two types of bedding, straw and wood sawdust, were evaluated. Several of the process parameters have been investigated on a pilot scale with approximately one-half ton batches and on a bench scale. These parameters include air flow rate, moisture content, temperature, pH, and agitation frequency. Dry matter was reduced about 60%. The total weight was reduced about 80%, including the effect of lowering the moisture content from 75 to 50% during the process. Volume was reduced 30 to 50% on a loose basis. The final product has a faint musty odor in a moist condition. It is odorless when air-dried to about 10% moisture content.
(Bundy-Iowa State)

### 0807-A4, B1, B2, C2, C3, D3, E1, E2

**QUALITY OF EFFLUENT FROM FARM ANIMAL PRODUCTION SITES,**
Louisiana Tech Univ., Ruston. Dept. of Agricultural Engineering.
J. W. D. Robbins, G. J. Kriz, and D. H. Howells.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 166-169, 5 fig, 4 tab, 4 ref.

Descriptors: *Farm wastes, Coliforms, Biochemical oxygen demand, Chemical oxygen demand, Carbon, Lagoons, Runoff, Water pollution sources, Water pollution control, Waste disposal.

Effluents from twelve animal production sites representing three types of waste management operations--land disposal, lagooning and direct discharge into streams--were measured and more than 1500 samples were collected for analyses. The water samples were analyzed for (a) bacterial densities--total coliforms, fecal coliforms and fecal streptococci; (b) degradable organics--biochemical oxygen demand, total organic carbon, total solids and volatile solids; and (c) nutrients--organic nitrogen, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, total phosphate and orthophosphate. Other measurements included pH, conductivity, initial dissolved oxygen and temperature. Site data were collected in order to evaluate the pollutional potential of each site and the management factors determining the amount of wastes that reached water courses. These data included the number and size of animals, types and amounts of feeds, types of waste handling facilities and practices, waste retention or drainage times, soil classifications, rainfall, temperature, flow rates and some characterization of wastes produced. Study results point to the need for and superiority of land disposal for animal wastes to effectively control water pollution. Direct dumping of animal wastes into streams is essentially predictable by characterization of fresh wastes and should be prohibited. Effluents from waste lagoons were found to exceed raw domestic sewage in strength and should not be discharged without further treatment. (Bundy-Iowa State)

### 0808-B2, C2, D3, F5

**WATER HYACINTHS TO FURTHER TREAT ANAEROBIC LAGOON EFFLUENT,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. R. Miner, J. W. Wooten, and J. D. Dodd.
In: Livestock Waste Management and Pollution Abatement, Proceedings, International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 170-173, 4 fig, 7 tab, 10 ref.

Descriptors: *Farm wastes, Water hyacinth, Aerobic treatment, Oxidation lagoons, Nitrogen, Phosphorus, Chemical oxygen demand, Waste water treatment.
Identifiers: *Anaerobic lagoon effluent.

Effluent from an anaerobic lagoon treating liquid swine manure was pumped through a series of four pools, each ten feet in diameter. Water hyacinths were grown on these pools in an effort to provide further treatment. The plants flourished, necessitating weekly harvesting of one-fourth of the growth. During the month of July 1970, nine pounds of ammonia were added to the system in the influent and less than one-fourth pound discharged in the effluent. During this same period, 28 pounds of COD were added and 2.6 pounds discharged. Extrapolating the system to a per acre basis indicates ammonium nitrogen removal to be in excess of 35 pounds per acre per day, COD removal to exceed 100 pounds per acre per day and phosphate removal to exceed 15 pounds per acre per day. Nitrate release was less than 0.3 pounds per acre per day. In one sample weekly harvest (Aug. 14 - Aug. 21), 450 plants with a total wet weight of 90 lbs. were removed from two of the ponds having a combined area of approximately 160 sq. ft. This corresponds to an increase of over 17,000 new plants per acre per day and an increase in wet weight of over 2500 pounds per acre per day. At a 4% dry weight conversion factor, this equals 100 pounds of dry weight per acre per day. The system has performed satisfactorily showing potential as a means of removing nutrients from partially treated animal wastes which are not removed by currently used processes. (Bundy-Iowa State)

### 0809-B1, C2, D1, D2, D3, F6

**ENZYME-FACILITATED MICROBIAL DECOMPOSITION OF CATTLE FEEDLOT MANURE,**
Colorado State Univ., Fort Collins. Dept. of Microbiology.
G. K. Elmund, S. M. Morrison, and D. W. Grant.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 174-175, 4 fig, 7 ref.

Descriptors: *Farm wastes, Cattle, Feed lots, Enzymes, Biochemical oxygen demand, Microbial degradation, Amino acids, Proteins.
Identifiers: *Enzymatic hydrolysis.

The cleavage of the macromolecular fraction is a rate-limiting step preceding its oxidation or assimilation during the initial microbial decomposition of cattle feedlot manure. Increasing the initial rate of hydrolysis of the macromolecules may stimulate the development of a microflora actively involved in the subsequent stages of the decomposition process. Methodologies have been developed to evaluate and optimize conditions for enzymatic hydrolysis of manure substrates as well as bioassay techniques to measure the resultant increased rates of microbial activity. The results of studies with proteolytic enzymes are presented as a model system. Fresh manure from feedlot cattle receiving a high concentrate ration was exhaustively dialyzed, lyophilized and ground in a Waring blender. The non-dialyzable manure components contained 94 percent of the dry matter of fresh manure. The material contained 275 mg/gm protein of which 75 mg/gm was soluble protein. After three hours incubation with Pronase B grade (Calbiochem), essentially all of the soluble and 17.5 percent of the insoluble protein was hydrolyzed. Enzymatic hydrolysis of the protein fraction of feedlot manure appears to significantly increase the initial rate of microbial oxidation of the manure substrate. The results give promise to the use of hydrolytic enzymes to facilitate the overall rate of manure decomposition.
(Bundy-Iowa State)

### 0810-C2, D3, F6

**WATER AND SOIL OXYGEN DEMAND OF LIVESTOCK WASTES,**
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. P. Taiganides, R. K. White, and R. L. Stroshine.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 176-179, 7 fig, 4 tab, 7 ref.

Descriptors: *Farm wastes, Sulfur, Carbon, Nitrogen, Waste treatment, Biochemical oxygen demand, Analytical techniques.
Identifiers: *Soil oxygen demand, Winkler method, Warburg respirometer.

The oxygen demands of animal manures placed in a water environment were measured using the standard BOD dilution-bottle technique and the Warburg respirometer method, using seeded and unseeded samples and incubating the samples at temperatures ranging from 12 deg. C to 28 deg. C. It was concluded that oxygen demand units should be reported in mg O2 per gram of total solids (mg/g TS) or as percent of TS. Seeding animal manure samples with supernatant from aerated sewage produced a significantly higher BOD curve than for unseeded samples. Total BOD (56 days at 20 deg. C) of animal manure constituted 40 to 50 percent of the COD, but the 5-day BOD is less than 14 percent of the COD of the same waste. Either the

Winkler method or oxygen meter may be used with similar accuracies in the measurement of dissolved oxygen in BOD bottles. Warburg respirometer is a good apparatus to use to determine oxygen demand of animal wastes. A test to measure the rate and ultimate oxygen demand of animal manure incorporated into top soil is called Soil Oxygen Demand (SOD). In the SOD test, waste is placed in an air-tight Warburg flask containing soil. As microbes decompose the waste, oxygen is consumed and carbon dioxide is released. The carbon dioxide is absorbed by a solution of 40 percent potassium hydroxide which is placed in a vial in the flask. The quantity of oxygen consumed is determined by measuring changes in the pressure in the flask and calculating the change in quantity of gas, using the ideal gas law. (Bundy-Iowa State)

## 0811-B2, B5, C2, F6

**BOD ANALYSIS OF SWINE WASTE AS AFFECTED BY FEED ADDITIVES,**
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
J. D. Ariail, F. J. Humenik, and G. J. Kriz.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 180-182. 8 fig, 3 ref.

Descriptors: *Farm wastes, Swine, Biochemical oxygen demand, Copper, Zinc, Sewage, Lagoons, Analytical techniques, Feeds.
Identifiers: *Feed antibiotics.

The effects of feed antibiotic, copper and zinc concentrations, and sample dilution upon the standard BOD5 analysis for swine wastes were investigated. Analyses were made on swine feces, lagoon influent and lagoon effluent. Antibiotic concentrations in the swine waste were found by modifying the AOAC (1965) microbiological method for the assay of chlortetracycline in animal feeds. The copper and zinc concentrations of digested samples were determined with an atomic absorption spectrophotometer. The amount of each inhibitory substance present in the BOD bottle for the various sample dilutions was determined. The amount of metal or antibiotic present was related to the amount of organics. Therefore all BOD dilutions that result in an acceptable oxygen depletion have similar concentrations of organics and inhibitory substances. Recommendations presented for the selection and determination of the most reliable BOD5 data for animal waste are different from commonly accepted criteria for obtaining the statistically best BOD5 results for domestic and industrial wastewater. The membrane filter technique outlined in Standard Methods for the determination of the fecal streptococcus content of sewage and animal waste is superior to the membrane filter technique utilizing Bacto-KF streptococcus broth.
(Bundy-Iowa State)

## 0812-A12, B3, B5, C3, F6

**PORCINE ENTEROVIRUS SURVIVAL AND ANAEROBIC SLUDGE DIGESTION,**
Illinois Univ., Urbana. Dept. of Microbiology; and Illinois Univ., Urbana. Dept. of Veterinary Pathology and Hygiene.
R. C. Meyer, F. C. Hinds, H. R. Isaacson, and T. D. Hinesly.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 183-184. 2 fig, 1 tab, 6 ref.

Descriptors: *Farm wastes, Sludge digestion, Viruses, Swine, Anaerobic digestion.

Little information is available on the effect of anaerobic sludge digestion upon viruses. Laboratory anaerobic digesters of 1 liter capacity were set up in duplicate employing sludge obtained from the local municipal sewage treatment plant. The digesters were monitored and upon stabilization after 4 to 5 days, they were seeded with 100 ml. of a virus suspension containing 10 deg PFU/ml. of a swine enterovirus. At time intervals ranging from 1/2 hr. to 12 days 25 ml. samples were withdrawn from each digester and pooled. The presence of infectious virus in the respective samples was determined by the capacity of a 20 ml. volume, upon oral administration, to infect 10-14 day old germ-free piglets. Fecal samples were collected from each pig twice a day (A.M. and P.M.) on the 3rd and 4th day post challenge and pooled. Possible infection of piglets by the indicator virus was determined by standard virologic procedures employing diploid porcine kidney cell cultures. Virus, when recovered from the piglets was identified by serologic procedures as the test agent. Virus could not be detected or demonstrated by pig challenge after the 4th day in the anaerobic digesters.
(Bundy-Iowa State)

## 0813-A6, B3, C1, D2, D3, E3

**THROUGH-CIRCULATION DRYING OF MANURE IN SUPERHEATED STEAM,**
Drexel Univ., Philadelphia, Pa. Dept. of Chemical Engineering.
J. R. Thygeson, E. D. Grossmann, and J. MacArthur.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 185-189. 7 fig, 1 tab, 6 ref.

Descriptors: *Farm wastes, *Drying, Odor, Moisture content, Waste treatment, Waste disposal, Steam.
Identifiers: *Superheated steam, Continuous conveyor dryer.

Treatment of livestock waste to produce a biochemically stable and odor free product capable of use as a feed additive, soil conditioner, or fuel is described. The process involves the drying of a packed bed of wet manure extrusions in a closed cycle system employing superheated steam as the drying medium. The prospective advantages of this method of waste treatment include: (1) high production rate per unit area of plant; (2) minimum environmental pollution associated with the process; (3) relative insensitivity to changes in environmental and feed conditions; (4) capability of treating the undiluted manure; (5) production of a stable, odorless, free-flowing solid convenient for storing or transporting. Preliminary experimental studies on the extrudability of the wet manure and on the pressure drop and drying characteristics of the packed bed indicate that the material can be dried successfully in a through-flow system. The steam was forced through the bed of wet extrusions in a laboratory-scale test apparatus which permitted easy removal of the test section for periodic weighing. The equipment was capable of achieving the following limits on the drying parameters: bed depth of 9 inches; superficial velocity of 1000 feet per minute; fluid temperature of 350 deg F; superheat equivalent to 140 deg F. Provision for pressure drop, flow, and temperature measurement was incorporated in the system.
(Bundy-Iowa State)

## 0814-A6, D2, E3

**PYROLYSIS OF LIVESTOCK WASTES,**
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
R. K. White, and E. P. Taiganides.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 190-191. 3 fig, 3 tab.

Descriptors: *Farm wastes, Anaerobic conditions, Poultry, Swine, Cattle, Thermal capacity, Odor, Waste treatment, Incineration.
Identifiers: *Pyrolysis.

Pyrolysis is the 'anaerobic' incineration of wastes in contrast to combustion which might be termed 'aerobic' incineration. Pyrolysis is the chemical decomposition of materials heated to high temperatures in the absence of free oxygen. Animal manures were heated to 800 deg C at a controlled rate and in an airtight vicor tube placed inside a standard muffle furnace. The released gases were collected by displacing a brine solution and their composition was determined by a standard burrett gas analyzer. Quantities of gas produced and their average composition are tabulated. Advantages of pyrolysis include the production of gases which can be reclaimed for heat energy and a dry and innocuous residue product with reduced volume.
(Bundy-Iowa State)

## 0815-B3, B4, C2, D1, D2

**DRYING POULTRY WASTE,**
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
T. C. Surbrook, C. C. Sheppard, J. S. Boyd, H. C. Zindel, and C. J. Flegal.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 192-194. 4 fig, 4 tab, 5 ref.

Descriptors: *Farm wastes, Odor, Drying, Proteins, Poultry, Potassium, Phosphorus, Temperature, Time, Storage.
Identifiers: Pneumatic drying process, High temperature drying.

Experiments were conducted to evaluate a commercial poultry excreta drier and to minimize nutrient losses in the resulting product. The output of this machine was 340 pounds per hour of dried poultry waste. Drying is a potential way of handling poultry wastes from an economic standpoint. The final product, dried poultry waste, is in a form which can be easily handled. Samples of dried poultry excreta show a wide (11-38 percent) variation in protein content. From 50 to 65 percent of the available protein remains in the dried poultry waste. Trials were conducted to relate protein loss to the amount of heat as measured at one point in the drier. In temperature ranges from 450 deg to 700 deg F, there was a range of three percent on a dry basis from the same unprocessed waste. Generally speaking, the low range of temperatures were less destructive of protein. There is a relationship between protein loss and storage time. This is not evident for 14 days or less storage time. Protein loss is evident for storage periods of four to six months in commercial poultry houses.
(Bundy-Iowa State)

## 0816-B1, C2, D3, E2, E3, F1

**ECONOMICS OF WASTE DISPOSAL FROM CONFINED LIVESTOCK,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Economics.
W. H. M. Morris.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 195-196. 4 tab, 3 ref.

Descriptors: *Farm wastes, *Economic feasibility, *Waste treatment, Aerobic treatment, Costs, Fertilizers, Nutrients, Waste disposal, Oxidation lagoons.
Identifiers: *Field spreading.

The costs of handling livestock wastes must be considered in the framework of the total production system, and this may change the location, volume, consistency, and composition of the waste. Furthermore, such items as slotted floors and oxidation ditches often comprise a large part of the total cost of a building. Under U.S. conditions, the cost of disposal of livestock wastes exceeds their value. No one system of disposal is the least costly or the most profitable under all circumstances. Factors such as the cost of labor and of capital and availability of land in different seasons determine the economically optimal system. No profitable method can be foreseen for industrial or domestic utilization of any significant part of the livestock waste produced. It is expected that the producer will continue to use the presently available systems of disposal for the foreseeable future. Spreading on land, anaerobic, and aerobic treatment and feeding all seem practical alternatives. The economic choice depends on the species, the environment, and many other factors. (Schmitt-Iowa State)

### 0817-B2,B3,B4,D1,D3,E1,F1

**MARKETING CONVERTED POULTRY MANURE,**
Pennsylvania State Univ., University Park. Dept. of Animal Industries.
H. C. Jordan.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 197-198.

Descriptors: *Farm wastes, *Fertilizers, *Nutrients, *Poultry, Market value, Byproducts, Odor, Nitrogen.
Identifiers: *Compost, Soil conditioner.

Surveys were sent to firms engaged in processing and marketing poultry manure as a fertilizer or organic soil conditioner. The needs for a marketable product are: (1) Total anaerobic microbe count must be reduced through drying to control odor; (2) Odor must be reduced to nil and then may be mashed with a plesant odor for lawn and garden trades; (3) Nitrogen in the form of urea and uric acid must be stabilized so that it is not released quickly and does not burn plants for lawn and garden sale; (4) The product must flow through a lawn spreader and be easy to handle for lawn and garden trade; (5) The product must be stored in bags without picking up water and giving off odor for lawn and garden market; (6) Advertising and sale must be done without 'poultry manure' in the name of the product because of consumer or buyer resistance, with the possible exceptions of industrial sales and naming an organic product 'composted poultry manure'. One may need to guard against negative advertising of odors, diseases, burning plants, and drawing flies.
(Schmitt-Iowa State)

### 0818-B2,B3,B4,D1,D3,E1,F1

**THE ECONOMICS OF SWINE WASTE DISPOSAL,**
Environmental Research and Applications, Inc., Wilton, Conn.
R. W. Okey, and S. Balakrishnan.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 199-203. 5 fig, 8 tab, 26 ref.

Descriptors: *Farm wastes, *Costs, *Economic feasibility, Aerobic treatment, Nitrification, Denitrification, Waste treatment, Waste disposal, Phosphorus.
Identifiers: Phosphorus removal.

It is desirable to codify and apply research findings from several applicable disciplines and to review the cost/effectiveness ratio of waste treatment procedures in the light of new pollution control laws. The essential requirements of treatment are considered to be the total stabilization of carbonaceous and nitrogenous materials with no creation of odors. Possible treatment methods include (1) ground disposal, (2) lagoon storage, (3) total oxidative treatment, (4) organic solids separation and treatment of the liquid stream, (5) primary treatment plus nitrogen and/or phosphorus removal and/or dissolved solids removal. The costs for waste treatment for a 5,000 animal swine system ranged from $17,600 for a 'solids separation prior to oxidative conversion of ammonia' system to $35,500 per year for a 'basic oxidation treatment with nitrogen and phosphorus removal' system. If total solids removal was required, the overall management costs of either system would be increased by $7,300 by adding a membrane system to remove all the inorganics. In addition, a satisfactory point of ultimate disposal must be found for the solids which were separated out. For small livestock systems, the cost per unit will be increased slightly for most treatments.
(Schmitt-Iowa State)

### 0819-A1, B2, B3, B4, D3, E2, F1, F2

**ECONOMIC IMPLICATIONS OF ENVIRONMENTAL QUALITY LEGISLATION FOR CONFINED ANIMAL FEEDING OPERATIONS,**
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
D. D. Badger, and G. R. Cross.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 204-207. 5 fig, 5 ref.

Descriptors: *Farm wastes, *Confinement pens, Costs, Regulation, Farm lagoons, Cattle, Hogs, Oklahoma, Waste treatment.

Recently instituted air and water quality standards and resulting State legislation have caused confined animal feeding operators to invest considerably more in construction and operation of their production system. Approaches being used to handle the animal waste and water runoff problem include stockpiling of manure, land spreading, use of oxidation ditches, and use of stabilization ponds. Beef wastes are handled mainly by scraping, loading, hauling, and dumping. Costs for this type of handling are 0.15 to 1.0 cents per pound of gain for sizable feedlots. Hog operations are generally either pasture, feeding flow-no lagoons, slotted or solid feeding floor with adjacent lagoon, or slotted floor with lagoon directly below. Pasture systems had waste handling costs of 0.5 to 0.1 cents per pound of gain, solid feed floor-no lagoon systems had costs of 1 to 0.2 cents per pound, and totally slotted floors had labor costs of 0.5 to 0.3 cents per pound of gain. Implications are that site selection will be much more critical in the future. Increased use of zoning to keep incompatible operations and urban areas separated will be necessary. (Schmitt-Iowa State)

### 0820-A2, A4, B1, B2, B3, E1, E2, F1

**COST OF MAINTAINING SPECIFIED LEVELS OF WATER POLLUTION CONTROL FOR CONFINED CATTLE FEEDING OPERATIONS FOR THE SOUTHERN HIGH PLAINS,**
Texas Tech Univ., Lubbock. Dept. of Agricultural Economics.
H. Y. Lee, and T. R. Owens.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 207-208. 1 fig, 5 ref.

Descriptors: *Farm wastes, *Cattle, *Agricultural runoff, Confinement pens. Feed lots, Costs, Texas, Water pollution control.
Identifiers: *Southern High Plains.

The Southern High Plains of the U.S. has witnessed the rapid expansion of confined cattle feeding operations. From less than 500,000 head of fed cattle marketed in 1959, the figure increased to over 2.5 million head by 1969 in the state of Texas alone. Surplus feed grain supply, abundant feeder cattle supply, dry and mild climate, gentle terrain, and an excellent transportation network contributed to the development. Some of these factors have also contributed to serious water pollution problems. An immediate solution to the problem might be the utilization of collection basins to collect feedlot runoff for subsequent discharge to an open field or modified playa lake or alternatively left for natural evaporation. The two runoff control systems are termed, respectively, 'mechanical discharge systems' and 'evaporative discharge systems'. Annual costs would range from $1,011 to $3,125 for 5,000 and 25,000 head lots, respectively. This is an average cost of 8.2 cents per head of occupancy. Disposing of solid manure is still a major problem with these systems. A 'modified environment system' consisting of concrete slotted floors and a roof covering the pen area and collection pits appears promising. This type of construction is estimated at about $75 per head, compared with $25 per head for a typical cattle feedlot.
(Schmitt-Iowa State)

### 0821-B2, B5, C2, D3, E2

**AN OXIDATION DITCH FOR THE HANDLING AND TREATMENT OF POULTRY WASTES,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. C. Loehr, D. F. Anderson, and A. C. Anthonisen.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 209-212, 5 fig, 3 tab, 5 ref.

Descriptors: *Farm wastes, *Aeration, *Aerobic treatment, *Poultry, Biochemical oxygen demand, Chemical oxygen demand, Waste storage, *Waste water treatment, *Oxidation lagoons.

An oxidation ditch was used to handle and treat poultry wastes from a cage layer operation. The results showed that an oxidation ditch is a reasonable alternative for handling, treatment and disposal of poultry wastes where odor control, liquid waste handling and reduction of the oxygen demand are desirable or necessary goals in a poultry operation. Mixed liquor should not be disposed of in surface waters; however, land disposal is an acceptable disposal method. There was no overflow from this ditch due to the high evaporation rate. The ditch acted as an aerated holding tank. Total solids exceeded 8% when the ditch was emptied after 274 days of operation. BOD5 was 4200 mg/l and total nitrogen was 3800 mg/l when the ditch was emptied in January 1971. Balances on the system showed 53 percent total solids, 62 percent volatile solids, 83 percent BOD5, 63 percent COD, and 31 percent of the total nitrogen were lost over the 274 day run. The original volume of the ditch was 1200 gallons. To offset 2100 gallons of evaporation, a total of 2900 gallons of water was added intermittently. After startup, the pH ranged from 5.0 to 6.5. Air flow in the control chamber was 3 to 5 cfm per bird for the 246 birds. (Schmitt-Iowa State)

### 0822-A6, B2, B5, C2, D3

**DESIGN, INSTALLATION AND BIOLOGICAL ASSESSMENT OF A PASVEER OXIDATION DITCH ON A LARGE BRITISH COLUMBIA SWINE FARM,**
Department of Agriculture, Abbotsford (British Columbia).
T. A. Windt, N. R. Bulley, and L. M. Staley.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 213-216. 1 tab, 7 fig, 11 ref.

Descriptors: *Farm wastes, *Aeration, *Oxidation lagoons, Hogs, Waste Storage, Biochemical oxygen demand, *Waste water treatment, Odor.
Identifiers: Pasveer ditch.

One 350 to 400 hog unit of a 25,000 commercial swine enterprise was equipped with a Pasveer oxidation ditch. The ditch was a capacity of 3,000 cubic feet and is approximately 220 feet long, 3 feet deep, and filled and maintained at a 22 inch liquid level. Hogs were placed in the structure in early June 1970. Foaming occurred about one month after placement and was controlled with an antifoam agent. The oxidation ditch has given complete odor control of the waste. The effluent from the ditch is easily handled by most pumps for final disposal. The cost of operating the 5 horsepower rotor for the ditch was about 25 cents per finished hog, at an electricity cost of 1.1 cents per Kw-hr. The oxygen concentration in the ditch measured at two-week intervals has varied from 3 to 6 ppm oxygen. The theoretical loading rate of volatile solids was based on a value of 5.9 pounds of volatile solids per day per 1000 pounds of live weight. The BOD has ranged from 600 to 2,000 ppm in the oxidation ditch, compared with a BOD value of 40,000 ppm for the raw 2aste. There seems to be a cyclic nature to the quality of contents in the oxidation ditch but this is not completely understood. (Schmitt-Iowa State)

### 0823-B2, B4, C1, C2, D3, E2

**BEEF WASTES AND THE OXIDATION DITCH TODAY AND TOMORROW,**
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
R. E. Larson, and J. A. Moore.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 217-219. 4 ref.

Descriptors: *Farm wastes, Aeration, *Oxidation lagoons, Waste storage, Cattle, Biological oxygen demand, *Waste water treatment.

The oxidation ditch can be operated as a batch system for treatment of beef animal wastes in cold climates. Its role as a management system, however, will be limited to that of collection, odorless temporary storage and partial treatment. Secondary and complete treatment of wastes will probably be accomplished by land disposal. In areas with below zero winter temperatures, a 'ditch' can be operated successfully for a 150-day batch period. After starting with a loading rate of 50 cu. ft. per animal, the solids concentration builds up to about 10-11%, which appears to be a maximum for successful operation. An estimated 20-30% REDUCTION IN SOLIDS HAS BEEN ACCOMPLISHED. These results and the other measured parameters indicate the design criteria for use of the oxidation ditch for beef systems will be very critical and additional research is necessary. There is also a need to study the interrelation between ventilation system design and the efficient operation of the ditch. Solids handling, especially with high roughage and whole grain rations, present some unsolved problems. (Schmitt-Iowa State)

### 0824-B2, B3, B4, C1, C2, D3

**AEROBIC TREATMENT OF LIQUID AND SOLID POULTRY MANURE,**
Guelph Univ. (Ontario).
J. Pos, R. G. Bell, and J. B. Robinson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 220-224. 7 tab, 6 fig, 11 ref.

Descriptors: *Farm wastes, *Oxidation lagoons, Biodegradation, Nitrification, Denitrification, Aeration, Poultry, Waste storage, *Waste water treatment.
Identifiers: *Compost.

Effects of aerobic treatment on liquid and solid poultry manure have been evaluated in a number of pilot studies. The changes in composition of liquid manure continuously aerated in 'fill and draw' oxidation ditches have been monitored over a number of 28-day storage periods over the last two years. While BOD reductions were less than had been expected on the basis of theoretical rotor efficiency, losses of nitrogen caused by nitrification-denitrification were very large and exceeded 50% of input as soon as active population of nitrifiers had become established. Solid manure aeration was evaluated in a drum fitted with an internal mixing rotor. The input consisted of equal volumes of poultry manure and soft wood shavings. The compost when discharged, after six days retention within the machine, was dark brown in color and had a strong but short-lived odor of ammonia. Although not completely stabilized, the compost could nevertheless be stored for extended periods of time without developing objectionable odors. (Schmitt- Iowa State)

### 0825-B5, C3,D3

**MICROBIOLOGICAL ASPECTS OF AEROBICALLY TREATED SWINE WASTE,**
School of Agriculture, Aberdeen (Scotland). Bacteriology Div.
K. Robinson, J. R. Saxon, and S. H. Baxter.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 225-228. 7 fig, 2 tab, 6 ref.

Descriptors: *Farm wastes, *Aerobic treatment, Aeration, Chemical oxygen demand, Salmonella, Streptococcus, Pathogenic bacteria, *Waste water treatment.
Identifiers: *Staphylococcus.

The aerobic microbial degradation of swine wastes was evaluated in field studies. Studies on the influence of diet on the composition of waste as a microbial substrate have shown the excretion of inhibitory levels of copper. Chemical analyses of some of the soluble components have made it possible to compare the rates of breakdown of these components with changes in pH and the rate of removal of Chemical Oxygen Demand. A progressive and marked fall in oxygen solubility occurs as the waste concentration increases. Suspensions of Salmonella, Streptococcus, or Staphylococcus were inoculated into aerating urine cultures; these organisms survive for periods exceeding 8 days. It is possible to produce a biologically stable effluent, occasionally with a satisfactory BOD, and a clean, odorless, residual solid. Further work is needed to show how the process of purification can be improved and more clearly understood. (Schmitt-Iowa State)

### 0826-A8, E2

**CROP PRODUCTION AND SOIL ANALYSES AS AFFECTED BY APPLICATIONS OF CATTLE FEEDLOT WASTE,**
Southwestern Great Plains Research Center, Bushland, Tex.
A. C. Mathers, and B. A. Stewart.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 229-234. 2 tab, 6 fig, 3 ref.

Descriptors: *Farm wastes, *Grain sorghum, *Crop response, Soil tests, Leaching, Nitrates, Cattle, Feed lots, Irrigation effects.

A field study was initiated in 1968 to determine the effect of varying rates of cattle feedlot waste on crop growth, nitrate content of forage, and accumulation of nitrate, chlorides, and other constituents in the soil profile. Rates of feedlot waste were 0, 10, 30, 60, 120, and 240 T/A applied to the same plots annually. One treatment received 240 T/A the first year only. Commercial fertilizer treatments of 240-0-0 and 240-50-50 lbs/A applied annually were also included to compare to the waste treated plots. Wastes were spread and plowed under in the spring. In 1969, the plots were not irrigated prior to seeding grain sorghum, but they were in 1970. Seasonal irrigations were applied as needed to provide adequate moisture for plant growth. Soil samples were taken before the experiment was started, at seeding times, and following harvests. Samples were analyzed for nitrate, nitrite, ammonium, chlorides, and conductivity. Yield values and soil analyses concerning the first two years of the study are presented and discussed. (Schmitt-Iowa State)

### 0827-A8, B2, C2, D3, E2

**A BARRIERED LANDSCAPE WATER RENOVATION SYSTEM FOR REMOVING PHOSPHATE AND NITROGEN FROM LIQUID FEEDLOT WASTE,**
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
A. E. Erickson, J. M. Tiedje, B. G. Ellis, and C. M. Hansen.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 232-234. 2 fig, 2 tab.

Descriptors: *Farm wastes, Nitrification, Denitrification, Nutrient removal, Feed lots, Hogs, *Waste water treatment.
Identifiers: *Barriered Landscape Water Renovation System.

A Barriered Landscape Water Renovation System (BLWRS) consists of an inexpensive impervious water barrier installed below the surface of sand soils. The barrier modifies the soil environment so that an aerobic zone and an anaerobic zone are formed in the soil. The liquid waste is spread on the aerobic zone where the organic matter is decomposed and the nitrogen compounds nitrified. The nitrate is leached into the anaerobic zone where denitrification takes place. The phosphate is removed from the system by adsorption on a phosphate adsorber and in the soil. The renovated water, low in adsorption on a phosphate adsorber and in the soil. The renovated water, low in nitrogen, phosphate, and organic matter, seeps off the edges of the barrier into the aquifer or the water can be collected and recycled. Anaerobic swine waste was spread on this barrier. The total nitrogen content of the wastewater was 440 ppm and of the effluent less than 2 ppm. The average phosphate content of the waste was 38 ppm and of the effluent 0.04 ppm of phosphate. This simple, inexpensive, and efficient way of disposal of feedlot wastewater will also protect surface and underground waters from contamination.
(Schmitt-Iowa State)

### 0828-A3, A4, A5, A8, E2, F1

**DISPOSAL OF BEEF MANURE BY DEEP PLOWING,**
Texas A and M.Univ., College Station. Dept. of Agricultural Engineering.
D. L. Reddell, W. H. Johnson, P. J. Lyerly, and P. Hobgood.
In: Livestock Waste Management and Pollution abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 235-238. 4 fig, 4 tab, 6 ref.

Descriptors: *Farm wastes, *Deep tillage, *Cost comparisons, Cattle, Crop production, Crop response, Trenches, Waste disposal.

Four tillage techniques for deep plowing large quantities of manure into the soil were evaluated at El Paso and Pecos, Texas, during the summer of 1970. The soil at El Paso is a sandy loam, with a sandy subsoil. The soil at Pecos is a silty clay loam. Up to 900 tons of manure per acre can be plowed under with a 30-inch moldboard plow at a minimum cost of 4.5 cents per ton. In sandy soils, the disk plow should be able to plow under at least 600 tons per acre with a minimum cost of 2.1 cents per ton. The 18-inch plow is limited to about 300 tons per acre. The trencher seems most versatile from the standpoint of high rates and soil penetration depths. The costs will be high and in the order of 50 cents per ton at the 900 ton level. The complete mixing of manure and soil as done by the trencher is impressive. At this time, the water quality program shows no serious pollution problem for surface water runoff. The soil water samples at the 4-foot depth indicate that denitrification is taking place. The major groundwater and soil pollution problem would appear to be from sodium chloride. (Schmitt- Iowa State)

## 0829-A3, A6, A10, B2, B3, E2

**WATER QUALITY OF RUNOFF FROM GRASSLAND APPLIED WITH LIQUID, SEMI-LIQUID, AND 'DRY' DAIRY WASTE,**
Auburn Univ., Ala. Dept. of Animal and Dairy Science.
T. A. McCaskey, G. H. Rollins, and J. A. Little.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 239-242. 1 fig, 5 tab, 4 ref.

Descriptors: *Farm wastes, *Return flow, Water quality, Cattle, Odor, Biochemical oxygen demand, Agricultural runoff, *Water reuse, Waste disposal.
Identifiers: *Field-spreading.

Dairy waste was applied to runoff plots to simulate rates of application employed on Auburn University Agr. Exp. Station: (a) irrigation of waste from a holding tank; (b) spreading by a tank wagon, and (c) conventional manure spreader for applying 'dry waste'. Irrigation of liquid manure on grassland at 0.96 toms per acre (dry basis) once each 3 weeks has been practiced with commercial equipment for 21 months. There were no significant odors, flies, or manure accumulation problems at the disposal site. The application of 0.6 tons per acre once or twice during a three-week period by a tank spreader for 19 months also did not cause any problems. The application of waste by the conventional method on permanent disposal sites at rates greater than 3.2 tons/acre once each three weeks resulted in marked accumulation of manure solids. Rates exceeding those accomplished with one or two applications per three-week cycle are not advised unless a cropping system is used. The average BOD5 was 147 mg/l for runoff from grassland applied with an accumulative total of 34 tons (dry basis) per acre as irrigated waste, 45 mg/l for 22 tons/acre of semi-liquid waste, 87 mg/l for 122 tons/acre dry waste, and 17 mg/l for the control. (Schmitt-Iowa State)

## 0830-A5, A8, C2, E2

**FATE OF INORGANIC FORMS OF N AND SALT FROM LAND-DISPOSED MANURES FROM DAIRIES,**
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
D. C. Adriano, P. F. Pratt, and S. E. Bishop.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 243-246. 1 fig, 7 tab, 8 ref.

Descriptors: *Farm wastes, *Nitrates, *Leaching, Ammonia, Denitrification, Salts, Chlorides, Cattle, Path of pollutants, Waste disposal.
Identifiers: *Field-spreading.

Because land disposal without pretreatment is the most common method of disposal of cattle wastes in Southern California, salts and nitrates in soils and groundwaters must become important factors in dairy waste management. Average nitrate-nitrogen concentrations of 92, 74, and 66 ppm in soil solutions at the 10 to 15 foot depth for corrals, pastures, and croplands, respectively were found in the Chino-Corona dairy area. These solutions will eventually reach the underlying groundwater, which at the time of sampling, had lower nitrate concentrations. Reducing the present cow population of 10 per disposal acre to about 3 per acre would keep nitrate-nitrogen levels at less than 10 ppm in soil solutions beyond the root zone, in soil profiles under croplands and pastures. Under existing conditions, manure from 20 dairy cows had about the same amount of salt as 3 acre-feet of irrigation water. Maximizing ammonia volatilization from manure before incorporation into the soil will reduce the nitrate-nitrogen pool in the soil.
(Schmitt-Iowa State)

## 0831-A8, B3, C2, E2

**EFFECT OF RATE OF POULTRY MANURE APPLICATION ON SELECTED SOIL CHEMICAL PROPERTIES,**
Arkansas Univ., Fayetteville. Dept. of Agronomy.
L. H. Hileman.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 247-248, 5 fig.

Descriptors: *Farm wastes, *Poultry, *Fertilization, Crop response, Salinity, Soil properties, *Soil chemical properties, Salts.
Identifiers: *Field-spreading.

Poultry manure, especially broiler litter, is a valuable by-product of the poultry industry. Long-time use by farmers has indicated soil imbalance results from continuous heavy applications. On a dry weight basis, broiler litter contains 4.11% nitrogen, 1.45% phosphorus, and 2.18% potassium. Broiler litter containing 26% moisture was mixed into the upper 4 inches of Ruston sandy loam, Sharkey clay loam, and Captina silt loam, at rates of 5, 10, 15, and 20 tons per acre for a greenhouse study. Ky-31 Fescue was planted but did not germinate. A rapid rise in soil temperature and in pH was noted on all soils. The ammonia released may react with the soil clay exchange capacity resulting in high levels of Ca, K, and Mg ions in the soil, contributing to the soluble salt level. Soil potassium levels increased greatly. High levels of potassium combined with ammonia inhibit the germination and growth of most crop plants. Even at the 5-ton rate, severe salt toxicity was found on all three soils three months after litter incorporation. Salt problems can be determined by soil conductivity measurement. (Schmitt- Iowa State)

## 0832-A5, A8, B2, B3, C2, E2

**GROUNDWATER POLLUTION DUE TO HIGH ORGANIC MANURE LOADINGS,**
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.
T. J. Concannon, and E. J. Genetelli.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 249-253, 4 fig, 3 tab, 15 ref.

Descriptors: *Farm wastes, *Groundwater, Water pollution, Salinity, Poultry, Fertilization, Bio-indicators, Sampling, Waste disposal.
Identifiers: *Groundwater pollution.

Four specific methods of disposing of organic manures utilize soil as the ultimate disposal media. These include lagooning, sanitary landfilling, subsoil injection, and the PFC method. All these methods could cause serious pollution of ground waters due to heavy loadings of organic and inorganic materials. Contaminants studied were total organic carbon (TOC), NH4+, SO4, PO4, Cl, Na, Mg, Ca, and K. Bacteriological analyses were also performed. Four loading rates, 0, 15, 30 and 45 tons of dry poultry solids per acre were used in field plots as well as laboratory soil columns. Although TOC concentration levels were high in the field plots, no significant difference could be found between control and treatments. Nitrate concentrations exceeded USPHS limits, but the levels were not significantly different from the control. Chloride concentration did not exceed USPHS limits, sulfate concentrations slightly exceeded the limits. All fecal coliform tests were negative. Soil columns provided a controlled means for studying the soil as an effective disposal media for solid waste. (Schmitt-Iowa State)

## 0833-A3, A8, B2, C2, D3, E2

**EFFECT OF MANURE HANDLING SYSTEMS ON PLANT NUTRIENT CYCLING,**
Wisconsin Univ., Madison. Dept. of Soil Science.
R. F. Hensler, W. H. Erhardt, and L. M. Walsh.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 254-257, 6 tab, 4 fig, 7 ref.

Descriptors: *Farm wastes, *Fertilization, *Crop response, Aeration, Farm lagoons, Nutrients, Cattle.
Identifiers: Plant nutrient cycling.

Fresh, fermented (stacked), aerobic liquid and anaerobic liquid cattle manure handling systems were compared with regard to plant nutrient utilization by corn. In greenhouse studies, dry matter yields and recovery of nitrogen, phosphorus, and potassium were about the same for fresh, fermented, and anaerobic liquid systems, but were significantly less for the aerobic liquid system. Total corn yields and recovery of nitrogen and phosphorus were not greatly affected by oat straw and wood shavings bedding rates up to 8%, but at the 16% rate, yields and nitrogen recovery generally were significantly lower. Regardless of the handling method, manure increased corn yields in field studies. Yield increases were greatest for fermented and anaerobic liquid manure applied in the spring. Runoff losses of total nitrogen ranged from 3 to 24 pounds per acre annually for winter applied manure as compared to about 3 pounds per acre for non-manured soil and spring-applied manure. The concentration of nutrients in the runoff was greater from the sod compared to the fallow soils and greater for fertilizer compared to manure treatments.
(Schmitt-Iowa State)

## 0834-A3, A6, A8, A10, B2, B2, B4, E2

**SUBSURFACE DISPOSAL OF LIQUID MANURE,**
Pennsylvania State Univ., University Park. Dept. of Soil Fertility.
H. D. Bartlett, and L. F. Marriott.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 258-260, 2 tab, 3 fig.

Descriptors: *Farm wastes, *Waste disposal, Underground waste disposal, Fertilization, Waste storage, Cattle.
Identifiers: Field-spreading.

The application of animal manure below the soil surface provides a disposal method which eliminates problems of odors, flies, and runoff. Available equipment applies liquid manure four inches below the surface at approximately one gallon per square foot, a rate approaching that of surface spreading practices. The annual application of 15 tons of dairy manure per acre added approximately 706 lb. N to the soil each year. Even after allowing for estimated crop removal and various losses other than through leaching, a considerable amount of N remained in the soil. Water soluble N accounted for about 160 lb. per acre in the 4 foot profile; it was assumed some moved below that level. The optimum rate of manure application is not substantially greater than that which will supply the maximum nitrogen required by any crop, plus some allowance for losses other than leaching. (Schmitt-Iowa

### 0835-B2, B4, C2, D3

**AEROBIC STORAGE OF POULTRY MANURE,**
Greenmount Agricultural and Horticultural Coll., Muckamore (Northern Ireland).
T. A. Stewart, and R. McIlwain.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University. April 19-22, 1971, p 261-262, 2 tab.

Descriptors: *Farm wastes, *Aeration, *Aerobic conditions, Waste assimilative capacity, Poultry, *Waste storage, *Oxidation lagoons.

The use of an oxidation ditch, built directly underneath a 936 bird set of California cages, to aerobically store poultry droppings has been investigated for the past two years. The 2-foot long rotor is fitted with angle-iron type blades and is driven by a 1.5 H.P. electric motor at a fixed speed of 120 r.p.m. Droppings output of the birds during the first year of operation averaged 245 lb. per day, giving a total solids loading of 59 lb., of which 7[illegible]% was volatile. The BOD of the fresh droppings during this period averaged 40,860 ppm., which was a daily BOD loading on the ditch of 10.3 lb. To avoid sedimentation, it was necessary to empty the ditch when the solids content of the liquid rose above 30,000 ppm. A nutrient budget at the end of the first yearly cycle showed that 43 percent of the total solids, 56 percent of the volatile solids, 60 percent of the COD and BOD and 66 percent of the nitrogen entering the ditch were lost through bacterial activity during storage. Foaming, floating feathers, and mechanical failure of rotor bearings were the main problems encountered. Electricity consumption averaged 1 kilowatt per hour. (Schmitt-Iowa State)

### 0836-A11, A12, B2, B4, C3, D3

**SURVIVAL AND DETECTION OF LEPTOSPIRES IN AERATED BEEF CATTLE MANURE,**
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
S. L. Diesch, B. S. Pomeroy, and E. R. Allred.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 263-266, 2 fig, 1 tab, 16 ref.

Descriptors: *Pathogenic bacteria, *Farm wastes, *Aeration, Cattle, Aerobic conditions, Waste storage, Pollutant identification, Oxidation lagoons, Public health.
Identifiers: Leptospira pomona.

Leptospira pomona, a pathogen capable of infecting both man and animals, was studied in an extended aeration method of animal manure treatment. A laboratory oxidation ditch model was developed for studying leptospires at simulated winter environmental conditions. A fluorescent antibody technique was developed and utilized for detection of leptospires. Findings indicate that pathogenic leptospires are capable of survival for up to 18 days in an aerated model oxidation ditch and 11 days in effluent and sludge. These findings do not determine the ability of leptospires isolated from a manure environment to establish infection of man and animals. There must be public concern for potential contamination of the environment and the development of health hazards because shedding of leptospires may occur for long periods of time in infected cattle. The disease is of major economic and public health importance and widespread in animal reservoirs. Treatment of sludge and effluents by chlorination or other methods is needed before discharge. (Schmitt-Iowa State)

### 0837-A6, B2, C2, D3

**AERATION WITH ORP CONTROL TO SUPPRESS ODORS EMITTED FROM LIQUID SWINE MANURE SYSTEMS,**
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
J. C. Converse, D. L. Day, J. T. Pfeffer, and B. A. Jones.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 267-271, 4 fig, 6 tab, 10 ref.

Descriptors: *Farm wastes, *Aeration, *Odor, Biodegradation, Hogs, Hydrogen sulfide, Organic acids, *Waste water treatment, Oxidation-reduction potential.

Five levels of aeration of a completely mixed liquid swine manure system were studied to determine the effect on odors produced and to study the degradation of manure under each system. Oxidation-Reduction Potential (ORP), pH, temperature, and dissolved oxygen levels of the mixed liquor were recorded daily. Analyses of the mixed liquor and off-gas were performed. The average ORP (E-cal) values for chambers 1 through 5 were +143, -212, -344, -425, -482 mv, respectively. An average D.O. of 4.68 mg/l was maintained in chamber 1 while measurable D.O. was only occasionally found in chamber 2, and never found in the remaining chambers. The total volatile acids concentration in chambers 2 and 3 was about 30 and 10 times less, respectively, than in chambers 4 and 5. The average total sulfides concentration in the mixed liquor of chambers 2 and 3 was about 22 and 3 times less, respectively, than in chamber 5. No hydrogen sulfide was found in the off-gases of chambers 1 and 2. Chambers 3, 4, and 5 had an average of 0.59, 5.78 and 21.57 mg/day as S washed from the off-gases. If the ORP in the liquid is maintained in a range from -300 mv to -340 mv and the pH is in the range from 7.7 to 8.5 the system will be relatively odorless when compared to systems undergoing anaerobic degradation. (Schmitt-Iowa State)

### 0838-B2, B4, C2, D3

**NITROGEN TRANSFORMATION DURING AEROBIC DIGESTION AND DENITRIFICATION OF DAIRY CATTLE WASTES,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
A. C. Chang, A. C. Dale, and J. M. Bell.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 272-274, 1 tab, 7 fig, 6 ref.

Descriptors: *Farm wastes, *Nitrification, *Denitrification, Aeration, Aerobic conditions, Cattle, Nitrogen cycle, *Waste water treatment.

Besides biodegradable material, livestock wastes also contain large amounts of plant nutrients, which cause pollution problems if they are released to the environment without control. This study investigates the fate of nitrogen during anaerobic digestion of dairy cattle wastes and seeks a possible way of removing nitrogen before final disposal. The reduction of total nitrogen was found mainly due to the volatilization of ammonia during the aerobic digestion. Temperature has a significant effect on the stability of the digested wastes. For complete denitrification of the digested dairy cattle waster, acclimated sludge and a sufficient supply of organic carbon are needed. The amount of glucose required for complete denitrification is 150 per cent of the amount theoretically calculated. This results in a 90 per cent reduction of total nitrogen. The amount of manure slurry needed for complete denitrification of digested dairy cattle manure is an equivalent of 149 mg COD per mg of oxidized nitrogen. With a sufficient supply of organic carbon, the average rate of denitrification is 13.26 mg of nitrogen per hour. (Schmitt-Iowa State)

### 0839-A4, B2, B3, C2, D3, E1, F1

**AEROBIC BIOLOGICAL BREAKDOWN OF FARM WASTE,**
Rijkszuivel Agrarische Afvalwater Dienst, Arnhem (Netherlands).
P. Ten Have.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 275-278, 1 fig, 7 tab, 1 ref.

Descriptors: *Farm wastes, *Denitrification, *Aeration, *Activated sludge, Aerobic conditions, Cattle, Hogs, Costs, Waste water treatment, Slurries.

One of the ways to reduce dung surpluses is the exposure to aerobic biological breakdown. The aim of this treatment is not only the reduction of the suspended solids in the manure, but also of the volume by producing effluents which are discharged to watercourses. When using the activated sludge process with a load of 200-300 g BOD per cubic meter per day, the effluent BOD is normally 50-100 ppm. The activated sludge settles very well (Sludge, volume index mostly below 50), so sludge levels greater than 10 Kg MLSS per cubic meter can be maintained. The result is a low sludge load of less than 30 g BOD per Kg MLSS per day. When pig slurry is treated, about 40 percent of the original solids has to be removed as surplus sludge. With urine only, breakdown reaches 75 percent. The surplus sludge must be disposed but has a smaller volume, better dewaterability, and lack of obnoxious odors. A large part of the nitrogen is lost by denitrification, with 30 percent discharged with the effluent. Biological degradation is only economically justified in The Netherlands when agricultural use is impossible within a range of more than about 10 kilometers. (Schmitt-Iowa State)

### 0840-A6, B2, B4, C2, D3

**LOW-VOLUME, SURFACE-LAYER, AERATION--CONDITIONED MANURE STORAGE,**
Clemson Univ., S.C. Dept. of Agricultural Engineering.
C. L. Barth, and L. B. Polkowski.

Descriptors: *Farm wastes, *Aeration, *Odor, *Waste storage, Cattle, Farm lagoons, Aerobic conditions, Waste water treatment, Slurries.
Identifiers: *Surface-layer aeration.

Storage periods for wastes up to six months are necessary to maintain the quality of water resources and to complement schemes for intensified livestock production. A preliminary investigation of the procedure of low volume, surface layer aeration of stored, diluted dairy manure was made. Air was introduced into the supernatant of stored manure at various rates and depths. The supernatant of properly aerated storage units was characterized by higher oxidation-reduction potential, dissolved oxygen, and pH than poorly aerated and anaerobic storage. It also had lower volatile organic acid, ammonia, BOD, suspended solids and odor intensity. The sludge of the well-aerated unit was characterized by higher solids

concentration and a distinct surface separating the sludge and supernatant zones. Low volume, surface layer aeration effectively reduced odor production, produced a scum-free surface and a more concentrated sludge layer. Favorable storage conditions were associated with ORP greater than -50 mv (Ec), D.O. greater than 1.0 mg/l and pH greater than 8.0. An aerated depth of 20 to 24 inches was desirable. After sixty days storage, about 85% of total volume, 85% of the COD and 79% of the nitrogen was recovered.
(Schmittelowa State)

### 0841-A6, B2, C2, D1, D3, E2

**SHORT TERM AERATION OF DAIRY CATTLE MANURE FOR IRRIGATION,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
J. R. Ogilvie, and A. C. Dale.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 283-285, 4 fig, 12 ref.

Descriptors: *Farm wastes, *Aeration, *Odor, Sprinkler irrigation, Waste storage, Cattle, Chemical oxygen demand, *Waste water treatment.

Short-term aeration reduces odors from dairy cattle wastes. This was demonstrated by use of a 2 H.P. floating aerator in a 15 foot diameter, 42 inch deep tank into which raw concrete yard manure was loaded in batch made to a maximum mixed liquor total solids content of 1.75 percent and a COD of 17,600 mg/l. Daily irrigation removed the excess liquid. The mixed liquor was odor free at all times, in the tank and on grassland. There is a conversion of soluble organics to cell material, as about 80% of the soluble COD is removed. The process requires very good mixing to prevent particles of roughage from settling. The mixing may be performed by a turbine in a baffled vessel or by a Kessener brush in a rectangular tank. Dilution of the raw manure is necessary to allow treatment but the extra two volumes of water are usually available from rainfall, washwater, or special addition. The volume of treatment facility is much reduced from the oxidation ditch. The input oxygen is the same or somewhat reduced. In cold climates, this process could be used with an additional aerated lagoon to take the winter effluent.
(Schmitt-Iowa State)

### 0842-A6, B2, C1, C2, C3, D1, D3, F1

**THE USE OF OXIDATION PONDS FOR POULTRY PROCESSING WASTE DISPOSAL,**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
R. L. Wesley, E. B. Hale, and H. C. Porter.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 286-287.

Descriptors: *Farm wastes, *Poultry, *Industrial wastes, Oxidation lagoons, Odor, Virginia, *Food processing industry.

Poultry processing waste is a suitable substrate for biological degradation by both aerobic and anaerobic bacteria. Several poultry processors in Virginia have faced varying stages of court litigation involving waste disposal. A team of specialists, including a biologist, an agricultural engineer, an agronomist, a sanitary engineer, a poultry processing specialist and a member of the State Water Control Board Staff were appointed by the Dean of Cooperative Extension Service at VPI to assist a processor with his problems. This group gathered the basic facts concerning the problems as follows: (a) total hydraulic load; (b) BOD 5; (c) total solids; (d) total dissolved solids; (e) D.O., and (f) fecal coliforms. These determinations were made on raw effluent, treated effluent, and on the receiving stream. A treatment system composed of a grease and grit trap, a series of lagoons and natural aeration was developed. These lagoons cover 8 acres, have a capacity of 12 million gallons, and provide a detention time of 81 days. Reductions are as follows: (a) 97% BOD removal; (b) 87% solids removal, and (c) fecal coliforms are less than 100/100 ml in the receiving stream. This treatment cost approximately $30,000.
(Schmitt-Iowa State)

### 0843-B2, C2, D3

**ACCLIMATIZATION RESPONSE TIME FOR AEROBIC WASTE DIGESTORS,**
Georgia Univ., Athens. Dept. of Agricultural Engineering.
D. T. Hill, and R. E. Smith.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 288-290, 5 fig, 2 tab, 5 ref.

Descriptors: *Farm wastes, *Activated sludge, Anaerobic digestion, Time lag, Biochemical oxygen demand, *Waste water treatment.
Identifiers: *Acclimatization time, Time constant.

Extant circumstances for many anaerobic swine waste lagoons in present use often ensure aperiodic effluents. The output from operating anaerobic lagoons is unacceptable for receiving streams. This research was conducted to establish design criteria for an aerobic activated -sludge reactor for use with the aperiodic effluents from anaerobic lagoons. Objectives were to determine a general prediction equation for the transient operation time as a function of the off time of an aperiodically operating treatment unit and to determine the effect of a low-maintenance aeration supply on the transient operation time of the aerobic process. The use of maintenance aeration was found to have no significant effect on the value of the acclimatization time. Since there was no solids removal during the study, acclimatization time was defined as the time necessary to achieve 63.6% BOD reduction in the liquid phase, and is referred to as a time constant. The acclimatization time ranged from 5.69 to 15.21 hours between zero and infinity for values of down time.
(Schmitt-Iowa State)

### 0844-A9, A12, B3, C2, C3, E2, F2

**REGULATORY ASPECTS OF RECYCLED LIVESTOCK AND POULTRY WASTES**
U. S. Department of Health, Education and Welfare Division of Nutritional Sciences, Rockville, Maryland.
J. C. Taylor.
Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, pp. 291-292, 15 ref.

Descriptors: *Farm wastes, *regulation, *recycling, administrative agencies, legislation, poultry.
Identifiers: *Food and Drug Administration, Federal Regulations.

Section 3.59 of the code of Federal Regulations is a formal statement of policy or interpretation under Subpart A of Title 21. It states that the Food and Drug Administration has not sanctioned and does not sanction the use of poultry litter as a feedstuff for animals. Poultry litter could contain drugs and antibiotics or their metabolites and disease organisms may be transmitted to other animals by using poultry litter in animal feed. Information thought useful for FDA to consider before changing its policy include: 1) a description of the processing methods and analytical controls, 2) degree of uniformity of the product, 3) status of pathogenic organisms or their toxic metabolites, 4) levels of pesticides, drugs, heavy metals, or other substances shown safe for animal consumption, and 5) No harmful residues from drugs, pesticides or other substances or from thier metabolites, degradation products, or derivatives should occur in the edible tissues or by-products of animals consuming the product. At this time, FDA does not have enough information to modify its regulation. (Schmitt - ISU).

### 0845-A11, B4, C3, D3, E3

**CATTLE MANURE AS FEED FOR CATTLE,**
Alabama Agricultural Experiment Station, Auburn. Dept. of Animal and Dairy Sciences.
W. B. Anthony.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 293-296, 2 fig, 11 tab, 10 ref.

Descriptors: *Farm wastes, *Recycling, *Cattle, *Animal pathology, Microorganisms, Nematodes, Feed lots, Feeds.
Identifiers: *Refeeding, Wastelage.

Manure from grain-fed steers was fermented by lactic acid bacteria and about 16% of the dry matter was converted to lactic acid. This lactic acid was neutralized by anhydrous ammonia and the final product contained 45% crude protein equivalent. When blended with corn, the ammoniated manure was readily consumed by sheep. Manure blended with ground corn in the ratio 1:1.5 (w/w) was a more efficient ration for finishing slaughter cattle than a balanced ration containing corn and supplement or corn, supplement, and ground hay. All manure voided by yearling steers fed in confinement was collected and made into wastelage (57 parts manure, 43 parts ground hay). The wastelage produced daily using the excreta from one full-fed yearling steer averaged 51 pounds. A portion (6 lb.) was fed to the steer that produced the manure and the remainder (45 lb.) was fed to a beef brood cow. Cottonseed meal added to a corn-wastelage ration did not appreciably increase animal gain. Spread of infection of internal parasites and other common ailments of feedlot cattle did not occur when manure was fed over a long period to cattle and sheep. Larvae of common stomach nematodes did not develop in wastelage. (Schmitt-Iowa State)

### 0846-A11, B3, C2, C3, D1, E3

**NUTRITIVE VALUE OF CHICKEN MANURE FOR CATTLE,**
Cornell Univ., Ithaca, N.Y. Dept. of Animal Science.
L. S. Bull, and J. T. Reid.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 297-300, 7 tab, 14 ref.

Descriptors: *Farm wastes, *Recycling, *Cattle, *Poultry, Animal pathology, Coliforms, Nutrient requirements, Costs.
Identifiers: *Air dried chicken manure.

Chicken manure, as voided, contains about 75 percent water and 4 percent nitrogen. 70 percent of the nitrogen is derived from urinary sources and 30 percent from fecal matter. More than 60 percent of the total nitrogen is in the form of uric acid, 9 to 10 percent in ammonium salts and the balance is part of the fecal material. The use of urea and ammonium salts by rumen microorganisms is well documented. Acceptability, intake, digestion, and balance trials were conducted with dairy cattle and steers to determine the value of air dried chicken manure (ADM) as a source of nitrogen, calcium, and phosphorus. The dry matter content of the ADM as fed was 81.5% and the percentages of crude protein, calcium, and phosphorus were 30.1, 7.6, and 1.2, respectively. The gross energy value was 2688 Kcal per Kg as fed. Palatability was not a serious diet problem as long as the ADM contained less than 20% moisture. ADM may be used as the sole source of supplemental N for steers and dairy cows fed low-protein basal diets. N, Ca, and P in ADM are readily available and well utilized by the animal. The economic advantages for producing ADM in large quantities are significant at current cost estimates. (Schmitt-Iowa State)

## 0847-A11, A12, B3, B4, C2, C3, D1, D2, E3

**STUDIES OF PROCESSING, NUTRITIONAL VALUE, AND PALATABILITY OF BROILER LITTER FOR RUMINANTS,**
Virginia Polytechnic Inst., Blacksburg. Dept. of Animal Science.
J. P. Fontenot, K. E. Webb, B. W. Harmon, R. E. Tucker, and W. E. C. Moore.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 301-304, 5 tab, 1 fig, 16 ref.

Descriptors: *Farm wastes, *Recycling, *Poultry, Cattle, Animal pathology, Nutrients, Waste treatment.
Identifiers: Poultry litter.

A possible public health hazard exists when poultry litter is fed to ruminants. The objectives of this research were to develop a sterilizing method which will destroy pathogenic organisms in broiler litter, to determine the effect of sterilizing methods on the nutritional value of litter, to study variation in chemical composition of litter among producers and to study the palatability of cattle rations containing litter. The use of dry heat at 150 degrees C for 4 hours or longer was the only method which was consistently effective in sterilizing broiler litter. Autoclaving and the use of beta-propiolactone or ethylene oxide did not consistently affect chemical composition of litter. The use of dry heat at 100 or 150 degrees C resulted in a substantial decrease in crude protein content. There was loss of ammonia upon dry heating. In a series of nitrogen balance trials with sheep, nitrogen utilization was similar for litter autoclaved for 40 minutes, dry heated at 150 degrees C for 4 hours, or acidified to pH 6 and dry heated at 150 degrees C for 4 hours. There was considerable variation in the chemical composition of poultry litter samples obtained from different areas. No substantial amounts of pesticide residues were detected in broiler litter or in tissue from animals fed processed litter. There appears to be adaptation to acceptability of litter by cattle. (Schmitt-Iowa State)

## 0848-A11, B3, E3

**DEHYDRATED POULTRY WASTE (DPW) AS A FEEDSTUFF IN POULTRY RATIONS,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, and H. C. Zindel.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 305-307. 7 tab, 9 ref.

Descriptors: *Farm wastes, *Recycling, *Poultry, Dehydration, Nutrients, Waste treatment.
Identifiers: Eggs, Dehydrated poultry wastes.

Poultry excreta, from caged layers, was collected and dehydrated. The resulting product of dehydration (DPW) was put into the diets fed growing chicks and laying hens to determine its nutritional value. The 4 week mean body weight of leghorn-type chicks was not influenced when up to 20 percent of the diet was DPW. When diets of 10 or 20 percent DPW were fed to broiler-type chicks, a significant reduction in mean body weights resulted at 4 weeks of age. Feed efficiency was inversely related to the level of DPW in the diet. In two laying experiments, involving leghorn-type laying hens, incorporation of up to 20 percent DPW did not influence egg production or feed efficiency to produce eggs. Egg quality factors were not adversely influenced by adding up to 40 percent DPW in the laying ration. Supplementation of the diets containing DPW in one experiment with calcium, phosphorus, methionine and energy had little influence on the criteria measured. The taste panel was unable to determine a difference between eggs from hens fed the control diet and eggs produced by hens fed diets containing 10, 20, and 30 percent DPW. (Schmitt-Iowa State)

## 0849-A11, B3, C2, E3

**DRIED ANIMAL WASTE AS A PROTEIN SUPPLEMENT FOR RUMINANTS,**
Michigan State Univ., East Lansing. Dept. of Animal Husbandry.
H. F. Bucholtz, H. E. Henderson, J. W. Thomas, and H. C. Zindel.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 308-310, 6 tab, 4 ref.

Descriptors: *Farm wastes, *Recycling, *Poultry, Dehydration, Nutrients, Ruminants, Proteins, Feeds.
Identifiers: Dehydrated poultry wastes.

A 134 day feeding trial utilizing nine yearling steers per group was employed in studying the value of dried poultry waste as a protein source for feed lot cattle. The ration was comprised of 80% corn silage and 20 percent shelled corn on a dry matter basis. Crude protein levels were adjusted to 12 percent of dry matter with one of the following protein supplements; dried poultry waste (DPW), 1/2 DPW - 1/2 urea, 1/2 DPW - 1/2 soybean meal, urea, and soybean meal. Average daily gain for the respective rations was: 2.75, 3.03, 2.88, 3.10, 3.35 pounds respectively. Gain differences were highly significant. Feed efficiency values were 10.43, 7.31, 8.14, 7.23, and 6.96 pounds respectively. The relatively poor performance of beef animals fed DPW may be related to the high proportion (32 percent) of product used in the ration. Digestibility and nitrogen balance values for sheep indicate that the animal manures can be successfully used as a source of energy and nitrogen in ruminant rations. From management and nutritional considerations, dehydrated animal wastes must contain more than 25 percent crude protein to economically compete with other supplemental nitrogen sources for ruminants. (Schmitt-Iowa State)

## 0850-A11, B3, D2, E3, F1

**THE EFFECTS OF INCLUDING DRIED POULTRY WASTE IN THE FEED OF LAYING HENS,**
Ministry of Agriculture, Fisheries and Food, Worcester (England). Poultry Husbandry Advisor.
B. Hodgetts.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 311-313, 9 tab, 12 ref.

Descriptors: *Farm wastes, *Recycling, *Dehydration, Poultry, Costs, Drying, Feeds.
Identifiers: Dehydrated poultry waste.

A farm trial was arranged to test the feasibility of including artificially dried poultry waste in the feed of a flock of 1800 caged laying hens. A flock of 800 birds was maintained as a control. The waste came directly from battery cages and was dried in a rotary drum type dryer. After preliminary trials it was decided to use an inclusion level of 10% dried poultry waste. After 58 weeks of lay, no real differences could be detected in terms of egg yield, mortality or egg gradings. The flock receiving dried poultry waste consumed 0.27 ounces of feed/bird/day less than the control. Body weight checks showed them to be 0.21 pounds/bird heavier at the end of the trial. The overall cost of the ration was reduced to $4.80 per ton by including dried poultry waste. This trial indicated that for the conditions prevailing it was technically, nutritionally and economically feasible to recycle poultry waste to the layers at a level of 10%. (Schmitt-Iowa State)

## 0851-A11, B3, D2, E3

**NUTRITIVE EVALUATIONS OF UNTREATED AND CHEMICALLY TREATED DAIRY CATTLE WASTES,**
Agricultural Research Service, Beltsville, Md. Animal Science Research Div.
L. W. Smith, H. K. Goering, and C. H. Gordon.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 314-318, 8 tab, 5 ref.

Descriptors: *Farm wastes, *Recycling, Drying, Cattle, Sheep, Nutrients, Chemical degradation, Lignins, Cellulose, Wood wastes, *Waste water treatment.

Studies were conducted to determine the extent to which digestibility of manure plus urine and hardwood sawdust (barn waste, BW) or manure alone was increased by chemical treatments when reused as feed for sheep. Dairy cattle wastes were collected from a gutter cleaner. BW were (1) untreated or treated by adding and mixing either, (2) 3% sodium hydroxide, (3) 3% sodium peroxide, or (4) 3% sodium chlorite with the wet wastes. All were stored in plastic-sheet covered piles for 4 weeks before drying with forced hot air. The four materials were ground through a 3/8 inch hammermill screen and mixed as 83% BW, 10% cornmeal, and 7% soybean meal. These were pelleted and fed ad lib in a completely randomized experiment for 30 days. During the last 7 days, consumptions and digestibilities were measured. Dry matter digestibilities were: untreated, 23.05; sodium hydroxide, 27.32; sodium peroxide, 34.63; and sodium chlorite, 35.28. Cell wall digestibilities were: 9.67, 10.50, 17.11, and 21.92, respectively. Digestibilities of chemical treated feces were not increased to the extent observed in nitro. The less than predicted fiber digestibility may be the result of rapid passage of fecal fiber through the rumen or less than optimum treatment conditions. (Schmitt-Iowa State)

## 0852-A11, B3, C2, D3, E3

**BIODEGRADED HEN MANURE AND ADULT HOUSE FLIES: THEIR NUTRITIONAL VALUE TO THE GROWING CHICK,**
Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.
C. C. Calvert, N. O. Morgan, and H. J. Eby.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 319-320, 6 tab, 4 ref.

Descriptors: *Farm wastes, *Recycling, *Insects, *Larvae, Poultry, Drying, Nutrients, Feeds.
Identifiers: House flies, Musca domestica.

Initial studies demonstrated the feasibility of using the house fly larvae to biodegrade or process caged laying hen manure. Studies conducted on the comparison of processed hen manure, fresh dried hen manure, and soybean meal used these materials to constitute 22% of the diet. The materials contained 2.7, 5.2 and 8.0% total Kjeldahl nitrogen, respectively. Chicks receiving the two types of manure in the three week growth studies weighed 93 grams less than those receiving soybean meal. 22% manure does not support optimum chick growth. Newly emerged house flies contain about 69% moisture, and the dry material

is 73% protein and 7% fat. Dried ground adult house flies were diluted with cellulose to bring the protein content to 50% and this material was substituted in the chick diet of the growing chick. The total amount of fly meal in the chick diet was 22% and this was compared with 22% of 50% soybean meal. The adult house fly meal supports growth equally as well as soybean meal during the first three weeks of the growing period.
(Schmitt-Iowa State)

### 0853-A8, A11, B3, E2

**RECYCLING BROILER HOUSE LITTER ON TALL FESCUE PASTURES AT DISPOSAL RATES AND EVIDENCE OF BEEF COW HEALTH PROBLEMS,**
Department of Agriculture, Watkinsville, Ga.
S. R. Wilkinson, J. A. Stuedemann, D. J. Williams, J. B. Jones, and R. N. Dawson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 321-324, 5 tab, 3 fig, 17 ref.

Descriptors: *Farm wastes, *Fertilizers, *Crop response, Nutrients, Cattle, Fescues, Animal pathology.
Identifiers: Grass tetany, Nitrate toxicity, Lipomatosis.

Grass tetany, nitrate toxicity, and lipomatosis problems have occurred with beef grazed in tall fescue pastures heavily fertilized with broiler litter. Two Kentucky-31 fescue pasture systems were initiated in 1968 with one receiving 9.3 M.T. dry broiler house litter per acre per year, and a control receiving a maximum of 202 Kg N per ha per year from inorganic sources. These pastures were treated as ecosystems and changes in soil, plant, and animal components were evaluated. Soil from the surface 5 cm of the littered pasture had a higher percent of the exchange complex saturated with K, higher water soluble P and NO3, and a lower C/N ratio. Plant samples showed increased total N and potentially toxic levels of NO3-N accumulations during summer months in the forage. Perloline levels in fescue varied from a low in early spring and fall (160 micro g/g) to a maximum in August (830 micro g/g). Differential rates of uptake of K/Ca/Mg during early spring resulted in grass having K/Ca + Mg ratios greater than 2.2. Fat necrosis was detected by rectal palpation in 2 of 21 and 7 of 21 cows after 1 and 2 years of study in the broiler littered fescue and none in 1 of 24 in the control herd. (Schmitt- Iowa State)

### 0854-A8, C2, E2

**MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
P. R. Goodrich, and E. J. Monke.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 325-328, 8 fig, 8 ref.

Descriptors: *Farm wastes, *Fertilizers, *Phosphorus, Nutrient removal, Phosphorus radioisotopes, Sprinkler irrigation, Leaching, Clay loam, Path of pollutants, Saturated soils.

The irrigation of animal wastes containing high concentrations of phosphate onto the soil was simulated. Two different soils and three concentrations of radioactive phosphate were used to dynamically trace the pollutant movement in saturated soil. The sandy loam with its higher clay content absorbed up to four times as much phosphate as did the sand used in this study. Soils do have a limited capacity to adsorb phosphate from solution. While this fact can be safely ignored with normal applications of phosphorus fertilizers, it must be determined and considered in the design of disposal fields for wastes where phosphorus concentrations can be quite high. The rate of absorption may be slower than implied by most literature references because the soil mass at any depth is unlikely to react quickly in total to the phosphorus influx. This was more true for the finer textured soils than for the coarser ones. Although the finer textured soils adsorbed more total phosphorus, the phosphorus front still reached depths much quicker than if the soil behind the front had been totally reactive. The linearized diffusion equation also predicted a much sharper adsorption front than was observed with the two soils tested. (Schmitt-Iowa State)

### 0855-A8, B2, C2, D3, E2

**TREATMENT OF LIVESTOCK-LAGOON EFFLUENT BY SOIL FILTRATION,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. K. Koelliker, J. R. Miner, C. E. Beer, and T. E. Hazen.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 329-333, 2 tab, 6 fig, 5 ref.

Descriptors: *Farm wastes, *Nutrient removal, Fertilization, Sprinkler irrigation, Farm lagoons, Leaching, Phosphorus, Nitrate, *Waste water treatment, Filtration, Iowa.
Identifiers: Soil filtration, Anaerobic lagoon effluent.

In Iowa, anaerobic manure lagoon effluent can be successfully treated and disposed of between mid-April and early November by sprinkler irrigation. To minimize the possibility of runoff, the application rate should be less than half the suggested infiltration rate for clear water on the same soil. On poorly drained soils, a total application of 2 inches was the amount that could be applied at 0.40 inch per hour without runoff. Soil filtration removed from 79-93 percent of the COD, 90-97 percent of the total P, and 48-67 percent of the total-N when 14.8 to 31.4 inches of lagoon effluent were applied in one season to field plots. The total-N is the constituent that likely will limit the amount of liquid that should be applied in a season because of high nitrate-N (130-190 mg/l N) found in the tile drainage with intense applications. 600 pounds per acre of N per season is recommended. Fescue, brome, and ryegrass have grown satisfactorily where lagoon effluent was applied as long as the soil did not remain flooded. Over a three year period, measures of the chloride ion, an indication of total salt content, show approaching equilibrium, the concentration in the tile drainage about equal to that of the lagoon effluent.
(Schmitt-Iowa State)

### 0856-A8, B2, E2

**GROWTH RESPONSE OF PLANTS UNDER SPRINKLER IRRIGATION WITH DAIRY WASTE,**
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman, C. C. Hortenstine, and J. M. Wing.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 334-337, 6 tab, 9 fig, 8 ref.

Descriptors: *Farm wastes, Sprinkler irrigation, Crop response, Fertilizers, Cattle, Nutrient removal, Leaching, Slurries.
Identifiers: Dairy wastes.

The soil-plant system was used as a sink for the nutrients in dairy waste. Manure slurry of about 0.2 percent solids was applied to plants by sprinkler irrigation at various rates to determine growth response curves. For oats the rates were 1/4, 1/2 and 1 inch per week, while sorghum received 0, 1 and 2 inches per week. Ground water samples were collected periodically and analyzed for nitrates and phosphates. Growth response of both crops is described quite well by the Mitscherlich equation, which emphasizes relative yield. Relative yields of oats were 40, 65, and 88 percent of optimum for application rates of 1/4, 1/2 and 1 inch per week respectively. Maximum yield (green weight) for oats was estimated to be 12.25 tons per hectare (5 tons/acre), while the value for sorghum-sudangrass was 90.7 tons per hectare (36.8 tons/acre). Oats grown with dairy manure measure up to those grown with inorganic fertilizer in chemical composition, palatability, and digestibility. (Schmitt-Iowa State)

### 0857-A8, B2, C2, D2, E2

**NITROGEN REMOVAL FROM SEWAGE WATERS BY PLANTS AND SOIL,**
Maryland Univ., College Park. Dept. of Agronomy.
V. Larsen, and J. H. Axley.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 338-340, 6 tab, 17 ref.

Descriptors: *Farm wastes, *Nutrient removal, *Soil filters, Denitrification, Nitrogen compounds, Ammonia, Leaching, Sewage disposal, Filtration.
Identifiers: Soil filtration.

The addition of 3000 pounds per acre of nitrogen, 50 tons of organic matter and 200 acre inches of water per year to plants and soil was studied in reference to changes in sewage as it entered the soil and passed through the soil to a depth of 30 feet. At this depth these waters were returned to the surface by pumps. By use of chloride as a tracer, ground water dilution estimates were made and a nitrogen balance sheet for the changes, losses, and destinations of nitrogen throughout the cycle was developed. The 65 ppm of N in sewage, when applied at a rate of 508 cm per year (200 inches per year), was reduced to 11 ppm of NO3-N after the sewage has passed through 3 meters of water unsaturated soil and 6 m of water saturated soil. Denitrification and immobilization of nitrogen were the two most important factors in nitrogen removal when treatment rates were 11.7 to 23.7 cm per week. (Schmitt-Iowa State)

### 0858-B2, B4, C2, C3, D1, D3, E2

**RENOVATION AND REUSE OF WATER FOR DILUTION AND HYDRAULIC TRANSPORT OF DAIRY CATTLE MANURE,**
Massachusetts Univ., Amherst. Dept. of Food and Agricultural Engineering.
R. E. Graves, J. T. Clayton, and R. G. Light.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, 341-344, 5 fig, 3 tab, 8 ref.

Descriptors: *Farm wastes, *Slurries, *Screens, Cattle, Aeration, Recycling, Coliforms, *Water reuse, Waste treatment.
Identifiers: Bar screening.

Slurries of dairy cattle manure contain many solids which form scum mats and sludges in holding tanks and cause other problems during treatment. A stationary sloping screen with a 0.02 inch bar spacing used as a pretreatment step removed over 50% of the total solids present in manure slurries ranging from 50:1 to 2:1 (water to wet manure by weight). Two aerated treatment systems were studied, one using settled screen effluent and the other the entire screen effluent. Each system was duplicated with one using recycled effluent in the loading slurry and the other using fresh water. No adverse affects on treatment operations were attributed to recirculation. There was little difference in the effluents between systems. Concentration of salts and minerals increased in the recirculated systems which might cause problems eventually. Population of two indicator organisms did not increase in the recycled systems. Clogging and damage to pumps and nozzles in irrigating systems is reduced for the screened liquid. Storage for intermittent application requires less volume, and scum mats are eliminated from ponds by screening. (Schmitt-Iowa State)

### 0859-D1

#### THE SEPARATION OF SOLID AND LIQUID PARTS OF PIG SLURRY,

Instituut voor Landbouwbedrijfsgebouwen, Wageningen (Netherlands).
J. C. Glerum, G. Klomp, and H. R. Poelma.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 345-347, 2 tab, 5 fig.

Descriptors: *Farm wastes, *Slurries, *Separation techniques, Sieve analysis, Sedimentation, Dewatering, Hogs, Waste treatment.
Identifiers: Centrisieve, Decanter centrifuge, Vibroscreen, Rotary vacuum filter.

Experiments designed to separate solid and liquid parts of pig slurry were made with a centrisieve, two decanter centrifuges, a rotary vacuum filter, a vibroscreen, and a sedimentation silo. With the aid of a centrisieve between 30 and 40% of the dry matter could be removed from pig slurry with a dry matter content of 5 to 8%. The separated material has a dry matter content of 14 to 19%. High demands are made on the homogenity and supply of the slurry. The material separated by the decanter centrifuge was quite dry, but the energy consumption per unit capacity was very high. The separation capacity of the vacuum filter equaled that of the decanter centrifuge but had a lower energy requirement. The separated material from the vibroscreen continued too wet and the capacity was also low. The sedimentation silo showed the biggest reduction of the slurry was initially high (15-19%) and the storage time was long. The centrisieve performed best based on results, capacity and initial expense. The sedimentation silo also performed well. (Schmitt-Iowa State)

### 0860-C1, D1

#### DEWATERING POULTRY MANURE BY CENTRIFUGATION,

Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
I. J. Ross, J. J. Begin, and T. M. Midden.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 348-350. 2 fig, 1 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Dewatering, Centrifugation, Waste water treatment, Moisture content, Time, Temperature.
Identifiers: Imperforate basket type centrifuge, Manure washing.

Poultry manure is excreted at a moisture content of approximately 75 percent (wet basis) and can be dewatered by centrifugation. Tests have been conducted to determine the amount of fluid that can be removed from fresh manure in an imperforate basket type centrifuge. The variables investigated include (1) time of centrifugation - 1 to 12 minutes, (2) centrifugal force - 2000 to 10,000 g, (3) initial moisture content - 75% to 95% and (4) temperature - 40 to 120 degrees F. As much as 40% of the water can be removed from the manure at 75% moisture content and as much as 70% can be removed at 95% moisture content. Time of centrifugation in a bowl centrifuge for 1 to 12 minutes has little effect on the percentage of water removed except at low relative centrifugal forces (RCF) and high solids concentrations. Increasing the RCF significantly affects the percentage of water removed only at high solids concentrations. Increasing the temperature in the range of 40 to 160 degrees F increases the percentage of water that can be removed by centrifugation. (Schmitt-Iowa State)

### 0861-A11, A12, C2, C3, E3

#### CONCENTRATION OF PROTEINACEOUS SOLIDS FROM OXIDATION DITCH MIXED--LIQUOR,

Illinois Univ., Urbana. Dept. of Agricultural Engineering.
L. W. Holmes, D. L. Day, and J. T. Pfeffer.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 351-354, 8 fig, 4 ref.

Descriptors: *Farm wastes, *Recycling, Aeration, *Centrifugation, Hogs, Nutrients, Proteins, Water reuse, Waste water treatment.

Biodegradation of swine waste in an under-the-floor oxidation ditch produces a mixed-liquor that contains minute, protein-rich particles. The 82.6 percent (dwb) portion of a swine ODML sample that passed through a 200 - mesh screen contained 75.6 percent (dwb) crude protein. Centrifuged samples of swine ODML contained a greater percentage (dwb) of crude protein and essential amino acids than corn. Centrifugation is one possible method of suspended solids concentration. The solid bowl basket-type centrifuge used in pilot plant trials was capable of concentrating the proteinaceous solids in swine ODML from an initial value of 1.2% S.S. to a desired concentration of 6 to 8 percent S.S. This represents a volume reduction of 85 percent. This removes a substantial amount of liquid that contains no measureable amino acids. COD reduction closely followed S.S. recovery values. Investigations into potential health hazards to man and animal arising from infection by pathogenic organisms in the manure will need to be conducted before this method of manure recycling may be advocated for common use. (Schmitt-Iowa State)

### 1000-B1

#### EQUIPMENT AND FACILITIES FOR MODERN METHODS OF SWINE MANURE DISPOSAL,

Oregon State University, Corvallis, Agricultural Experiment Station.
A. J. Muehling.
Reports of the Twelfth Annual Swine Day, December, 1970, p. 17-23, 8 fig.

Descriptors: *Farm wastes, *Waste disposal, *Hogs, Feed lots.
Identifiers: *Building design, Slotted Floors, Farrowing house, Construction methods, Nursery, building, Finishing building, Sow confinement, Hog production systems.

The use of slotted floors in swine housing has accelerated the use of confinement housing in hog production systems in the United States. Specific facilities which are necessary for swine production and which successfully employ the slotted floors are described. Detailed instructions for constructing the farrowing house, nursery building, and finishing building are given. Concrete slotted floors appear to endure better than wood or steel. However, manure probably is worked through expanded metal better than almost any other slotted floor material. All types of slotted floor materials are considered. The advantages of various construction materials and methods are discussed. Floor plans and pictures depict the actual building structures and give additional construction information. (Dudley - East Central)

### 1001-A6, C3, D3

#### INCLINED-PLANE TRICKLING FILTER FOR SWINE WASTE,

University of Georgia, Athens, Agricultural Engineering Department.
L. A. Mulkey, and R. E. Smith.
Presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-952, Order No. N172 - 952, 16 p., 3 tab., 1 fig., 14 ref.

Descriptors: *Waste treatment, *Aerobic treatment, Odor, *Trickling filters, Flow rates, *Biochemical oxygen demand, Farm wastes, *Hogs, Feed lots.
Identifiers: *Inclined plane, Contact time, Organic removal, Psychoda fly larvae, Design equations.

Operating results of an aerobic inclined plane trickling filter to treat swine wastes are reported. The results indicate that this device can be used as a component in a waste handling system. The organic removal is erratic due to Psychoda fly larvae but a definite relationship exists and the equation $s/s_0 = \exp(-0.03L/Q)$ (where $s/s_0$ = BOD concentration ratio, L = plane length in feet and Q = flow rate in gal/hr-ft) may be used as a design guide in waste handling systems. Contact time for wastewater and biological growth is determined by $t_0 = 17.25\ L/Q$. Odor control was found to be a desirable attribute of the system and actions of macroorgonisms could aid in the transport of organic solids across the inclined plane. (Marquard - East Central)

### 1002-A6, A7, F2

#### USING ODOR INTENSITY LIMITS IN AIR QUALITY STANDARDS,

Clemson University, Clemson, South Carolina, Department of Agricultural Engineering.
C. L. Barth.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-441, 3 tab., 19 ref.

Descriptors: *Air pollution, *Odor, *Regulation, Clean Air Act, *Farm wastes, Livestock, Measurement, Quality, Feed lots.
Identifiers: Intensity, Primary odor list, Syringe dilution procedure, Osometer.

Because problems with the production and control of animal agricultural odors are sure to continue, tighter regulations governing odor intensities will occur. Related difficulties are: (1) Problems in establishing a list of basic odors, (2) difficulty in measuring odor intensities and in making objective odor quality measurements. Regulations governing odor control vary greatly from state to state. Conditions and terminology for odor control need to become more uniform. The status of odor regulations for each state is given. (Dudley - East Central).

### 1003-A2, A4, A5, A7, B2, B3, E1, E2

#### CATTLE FEEDLOTS AND THE ENVIRONMENT,

Environmental Protection Agency, Seattle, Washington.
Cattle Feedlots and the Environment, U. S. Environmental Protection Agency, Region X, Seattle, Washington, April, 1972, 63 p., 6 tab., 35 fig., 8 ref.

Descriptors: *Feed lots, *Design criteria, *Air pollution, *Water pollution, Farm wastes, Lagoons, Runoff, Waste Disposal, Pacific Northwest U.S.
Identifiers: Waste management, Site selection, Manure mounds.

This Environmental Protection Agency booklet presents comprehensive guidelines for the control and abatement of pollution originating from cattle feedlot operations, Feedlot wastes should be considered a natural resource capable of being recycled. Proper site selection, feedlot design, and management are needed to accomplish this. Site selection is the most important factor in minimizing water pollution, Guidelines call for feedlots to be isolated from waterways and outside of a 10 year flood plain. Feedlot design should retain all wastes on the premises until ultimate disposal. This may be done by manure mounds, holding ponds, or lagoons. Land disposal is currently the only industry-wide method acceptable for ultimate disposal of feedlot wastes. (Marquard - East Central).

### 1004-A6, A7, B4, C1, C2

**CORRELATING OIL AND ODOROUS COMPONENTS IN STORED DAIRY, MANURE,**

Clemson University, Clemson, South Carolina, and University of Wisconsin, Madison.
C. L. Barth, D. T. Hill, and L. B. Polkowski.
Paper presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972; Paper No. 72-950, Order No. M172-950, 17 p., 3 tab., 9 fig., 24 ref.

Descriptors: *Odor, *Chemical properties, Physical properties, Air pollution, Dairy industry, *Farm wastes, Cattle, Waste storage, Ammonia, Hydrogen sulfide,
Indentifiers: *Odor intensity index, Liquified waste management, Odorants, Volatile organic acid, Acetic acid, pH.

Three common odorants were identified and measured in stored dairy manure. A panel was selected to judge these odors which were present in only one of three flasks per set. The odorous flasks represented various degrees of aeration treatment. Results of the experiment showed that odorous components derived from lower aeration depths were the most difficult to distinguish. An odor intensity index (OII) was established from the experimental results. Volatile organic acid correlated best with the OII. Second best was hydrogen sulfide and poorest was ammonia. (Frantz - East Central).

### 1005-A2, A4, B2, B4, C2, D3, E2

**FACILITY DESIGN**

Wilson Company, Engineers & Architects, Salina, Kansas.
R. E. Crawford.
Presented at the Continuing Education Seminar: Topeka, Kansas, January 23, 1969; Hutchinson, Kansas, January 28, 1969, 14 p., 9 tab.

Descriptors: *Feed lots, *Runoff, *Water pollution control, Design, *Farm wastes, Livestock, Hydrology, Precipitation, Waste treatment, Waste storage, *Waste disposal, Irrigation.
Identifiers: *Waste management facilities.

Runoff control is an integral part of feedlot operation and cost. The principle steps are collection, storage and/or treatment and ultimate disposal. Biochemical oxygen demand, chemical oxygen demand, and dissolved oxygen data were taken to determine streamflow conditions due to feedlot runoff. Runoff variables of size of feedlot, topography', stream location, and flow and precipitation patterns were studied. At present the use of a retention system appears to be the most economical solution to preventing stream pollution from feedlot runoff. Two general plans involving holding basins of ponds are examined in detail. (Wetherill - East Central).

### 1006-A11, B1, F1

**HYPOTHALAMIC TEMPERATURE REGULATION IN CATTLE,**

Texas A&M University, College Station.
R. E. Stewart, and E. M. Bailey, Jr.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-511, 20 p., 2 tab., 10 fig., 9 ref.

Descriptors: *Cattle, *Temperature control, Humidity.
Identifiers: *Hypothalmus, *Craniotomy, Cannalae, Respiration rate, Thermal environment, Eypothalmic heating, Rectal temperature, *Lypothalmic temperature.

It was theorized that routine access to the hypothalamus by the means of in-dwelling cannulae would allow rapid testing of efficiency in control of body temperature of cattle. A semi-stereotaxic method for cannulae installation was developed. The heat loss center of two female beef calves was heated by RF energy; some degree of correlation was observed between hypothalamic temperature and respiration rate. Animals were subjected to a step change in thermal environment (73° to 95° with very high humidity); rectal and hypothalamic temperatures were found to be coupled by the respiration rate, with marked individual differences. The approach appears to have merits as a system for rapid indentification of heat tolerant breeds and individuals. (Wetherill - East Central).

### 1007-E1, E2, F1

**FEEDERS SCOLDED FOR FAILING TO LEARN THEIR "MANURE ECONOMICS",**

Beef, Vol. 9, No. 7, p. 43, 66, March, 1973, 1 fig.

Descriptors: *Farm wastes, *Economics, Cattle, *Feedlots, *Waste disposal, Fertilizer, Texas, Irrigation.
Identifiers: Retention ponds, Playa lakes.

In these excerpts from a speech given at U.S. Department of Agriculture Southwestern Great Plains Research Center, Bushland, Texas, feedlot operators are urged to familiarize themselves with the economics of animal wastes used as fertilizers. The approximately one ton of manure a steer produces while in the feedlot is viewed as a liability by most feeders. Manure can be an economic opportunity for the operator who takes the time and makes the effort to turn it into a marketable commodity. (Wetherill - East Central).

### 1008-A2, A4, A5, A6, A8, D3, E2

**ANIMAL WASTE DISPOSAL AND CONTROL OF FEEDLOT RUNOFF,**

Cooperative effort of Northern Plains Branch, Soil and Water Conservation Research Division, ARS, USDA, and the departments of Agronomy and Agricultural Engineering, Nebraska Agricultural Experiment Station - Headquarters in Lincoln, Nebraska, 4 p., 29 ref.

Descriptors: Feed lots, *Waste disposal, *Runoff, *Water pollution, *Soil contamination, Farm wastes, Cattle, Odor, Groundwater, Terraces, Sedimentation, Irrigation, Water table, Nitrates, Nebraska.

Evaluation and control of soil and water pollution from cattle feedlots and studies of the factors affecting feedlot pollution potential are the objectives of research studies initiated at Lincoln, Nebraska in 1968. Emphasis is on waterborne materials, but attention is also given to air transport and odor problems. Terrain, water table, runoff, sedimentation, vitrate concentrations, and climatic factors are studied at four test sites. Soil core samples confirm that flat feedlots are not major contributors to groundwater pollution. Corn fields were increased and no problems of nitrate or salt accumulations were discovered after application of runoff effluent to crops. Oxidation ditch studies have shown that, with aerobic maintenance of the ditch, odors are absent. Plans have been completed for two additional research sites. (Wetherill - East Central).

### 1009-A2, A4, B2, C1, C2, E2

**STREAM POLLUTION FROM CATTLE FEEDLOT RUNOFF**

R. K. White.
Project Completion Report No. 393X, United States Department of Interior, December, 1972, 33 p., 5 tab., 14 fig., 5 ref.

Descriptors: *Water pollution, *Cattle, *Farm wastes, *Feed lots, Runoff, Biochemical oxygen demand, Nitrogen, Water quality, Climates, Rainfall, Waste disposal, Irrigation, Ohio,

The extent to which downstream waters are polluted by animal wastes from barnlot runoff is studied. Sixty beef steers were placed in a .42 acre unpaved barnlot with a 13% southern slope. They remained there from November to May. Barnlot runoff was discharged into an intermittent waterway through an H-flume. Samples were collected in gallon bottles and kept at 4° C. Results show runoff occurs with a .5 inch rain. Biochemical oxygen demand concentration and transport were higher in winter and less in summer. Antecedent soil moisture conditions significantly affect the amounts of solids, biochemical oxygen demand, and chemical oxygen demand in the runoff, with increased amounts following dry periods. Runoff can be reduced by utilizing grassed waterways or collection ponds and irrigation. (Marquard - East Central).

### 1010-A2, A4, A5, A7, A8, B1, B4, D3, F2, F4

**PROCEEDINGS: LIVESTOCK WASTE MANAGEMENT RESEARCH REVIEW,**

Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, 133 p., November 29-30, 1972, 2 tab., 98 ref.

Descriptors: *Livestock, *Farm wastes, *Management, *Air pollution, Water pollution, *Soil contamination, *Waste treatment, *Waste storage, *Waste disposal, Runoff, *Feed lots, *Nebraska.

This multi-disciplinary team effort revealed the objectives and priorities in fighting agricultural pollution. Specific governmental and university programs were pinpointed, outlined, and reviewed. The papers presented were, in most instances, rather general. (Frantz - East Central),

### 1011-A2, A4, A6, A7, A8, E2, E3, E4

**NATIONAL LIVESTOCK WASTE MANAGEMENT PROGRAM,**

Agricultural Research Service, Beltsville, Maryland, U.S. Department of Agriculture.
R. G. Yeck.

Descriptors: *Farm wastes, *Feed lots, Groundwater, Recycling, *Livestock, Air pollution, Water pollution, Soil contamination, Runoff, Waste disposal, Waste treatment, Odor, Nebraska.
Identifiers: *Livestock waste management research.

Farm waste research project areas are discussed in an overview. Some areas of research receive adequate concentration while other topics such as recycling farm wastes, are inadequately considered. Projects which need perfecting include those seeking to control feedlot runoff and odor due to land applications of farm wastes. Researchers are urged to cooperate and to work concurrently on related projects to prevent land, air, and water pollution. Recent cuts into research allocations necessitate increased teamwork. (Frantz - East Central).

### 1012-A1, B1, F3

**REGIONAL LIVESTOCK WASTE MANAGEMENT PROGRAM,**

R. W. Kleis.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 11-15, November 29-30, 1972. 1 tab,

Descriptors: *Research and development, *Livestock, *Farm wastes, Management, Air pollution, Water pollution, Waste treatment, Waste storage, Waste disposal, Recycling, Nitrogen, Nutrients, Confinement pens.
Identifiers: *Soil, U.S. Department of Agriculture, Environmental Protection Agency.

Livestock waste management projects and objectives are listed for state agricultural experiment stations. The primary purpose is to enhance the total effectiveness of all participating agencies and institutions while preventing unnecessary duplication. Present efforts have been building up, as have problems of waste management, for fifteen years. Needed are projections of not only economic costs, but also of social and environmental costs. (Frantz - East Central).

### 1013-A4, A5, A6, A7, B4, E2

**POLLUTION OF AIR, WATER, AND SOIL BY LIVESTOCK,**

U.S. Department of Agriculture, Lincoln, Nebraska.

L. F. Elliott.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 23-28, November 29-30, 1972, 28 ref.

Descriptors: *Air pollution, *Water pollution, *Soil contamination, *Farm wastes, Feedlots, Odor, Surface waters, Groundwaters, Livestock.
Identifiers: Spectroscopy Chromatography, Nitrates, Oxidation, Soil profiles, Nebraska, Kansas.

Air, water, and soil pollution research projects are discussed. Air pollution studies include attempts at developing compounds which can reliably indicate odors. While surface water pollution from feedlots is no longer deemed a major problem, research has been necessary for the prevention of soil pollution and groundwater pollution at feedlot sites. Sealants in holding ponds and debris basins and management practices for land application of feedlot wastes are also being studied. (Frantz - East Central).

### 1014-A2, A3, B2, B3, D1, D2,D3, E2, E3, F3

**APPLICATION, UTILIZATION AND DISPOSAL OF LIVESTOCK WASTE,**
University of Nebraska, Lincoln, Agricultural Engineering Department.
H. Wittmus.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 31-35, November 29-30, 1972.

Descriptors: *Waste disposal, *Waste treatment, *Farm wastes, *Livestock, Feed lots, Runoff, Irrigation, Nitrates, Nebraska, Kansas, North Dakota.
Identifiers: Mounding.

Disposal from unpaved, beef cattle feed lots has the greatest pollution potential. Separation of liquid and solid wastes is important. Separated liquids have been applied at up to 36 inches a year for two years without problems, however, long range effects of effluent application need further study. Likewise needed is the determination of the highest sustained rates at which solid wastes may be applied without soil deterioration and salinization. Mounding sometimes aids in denitrifying wastes. Other waste management systems used with varying degrees of success are: (1) drying entire waste, (2) incineration, (3) composting, (4) refeeding, (5) protein production, (6) building blocks, (7) raw material for oil, (8) methane production. Frantz-East Central).

### 1015-A2, A6, B2, D1, E2, F1

**DESIGN AND MANAGEMENT OF RUNOFF SYSTEMS,**
Agricultural Research Service, Lincoln, Nebraska, U. S. Department of Agriculture.
J. A. Nienaber.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 39-43, November 29-30, 1972, 18 ref.

Descriptors: *Farm wastes, *Feed lots, Cattle, *Runoff, Drainage, Flumes, Terracing, Nebraska.
Identifiers: *Runoff control system, Debris basin, Holding pond, Disposal area.

A runoff control system has been successfully operated on two 1000 head feedlots. Designed from the University of Nebraska Field Laboratory, the system consists of three components: debris basin, holding pond, and controlled disposal area. This system was proven superior to the one-pond system for liquid and solid wastes. Broad basin terraces may be beneficial in flood protection as well as in runoff control. Shallow debris basins are recommended for minimizing waste odors. Wooden dams with crushed rock release runoff from debris basins. The suggested disposal area is from one half up to the full size of the feedlot itself. Rainfall, slope length, and size of operation are among factors which affect runoff control design. Alternative runoff control systems and their relative costs are discussed. (Frantz - East Central).

### 1016-A2, A4,A5, C1, C2, C3, F3

**CHARACTERISTICS OF ANIMAL WASTES AND RUNOFF,**
U. S. Department of Agriculture, Lincoln, Nebraska,
J. R. Ellis.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 49-53, November 29-30, 1972, 29 ref.

Descriptors: *Conductivity, *Farm wastes, *Runoff, Thermal properties, Nutrients, Nitrates, Phosphorus, Ammonia, Pathogenic bacteria, Water pollution, *Physical Properties, *Chemical properties, *Biological properties, Animal parasites, Amino acids, Waste disposal.
Identifiers: *Pollution potential, Waste management.

Chemical, physical, and biological properties of farm wastes must be further studied to correctly determine the pollution and management problems they present. The pollution potential discharged into streams requires chemical analysis of farm wastes, while design of runoff control structures lends itself to determination of physical properties. Further research is likewise needed in assessing life of microorganisms in feces and in runoff control systems. Because comparatively little information has been established regarding the physical properties of farm wastes, further research is suggested in characterizing feces, urine, and housed feed lot wastes, especially regarding gross energy, freezing point, and thermoconductivity. (Frantz - East Central).

### 1017-A11, B1

**WASTE MANAGEMENT AND ANIMAL PERFORMANCE,**
University of Nebraska, Lincoln, Animal Science Department.
S. Farlin.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 57-59, November 29-30, 1972, 5 ref.

Descriptors: *Feed lots, *Farm wastes, *Waste treatment, Nutrition, Nebraska, Missouri, Iowa, Minnesota.
Identifiers: *Gains, Animal performance, Mounding, Cold/warm slot housing.

Increasing animal performance, hence profits, depends upon feed lot modifications such as mounding wastes in winter and decreasing cattle density. Also, cattle with access to sheltered lots generally show increased gains, higher grade carcasses, and higher dressing percentages than cattle in open lots. Additional research may be the key to making more accurate estimates on the effects of housing and waste management on returns from feeding cattle. (Frantz - East Central).

### 1018-A6, B1, B2, E1, F3

**EDUCATION, ACTION AND REGULATORY PROBLEMS OF ANIMAL WASTE MANAGEMENT,**
University of Nebraska, Lincoln, Department of Agricultural Engineering.
E. A. Olson.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, November 29-30, 1972, p. 63-66.

Descriptors: *Nebraska, *Economics, Oxidation lagoons, Hogs, *Waste disposal, Ventilation, Farm wastes, Odor, *Feed lots, Cattle, Hogs, Inlets (waterways).
Identifiers: *Nebraska Livestock Feeders Association, Department of Environmental Control, Voluntary waste control, Regulatory waste control, American Soil Conservation Society, Rural Economic Agricultural Programs.

Problems associated with shifting from voluntary waste control to regulations adopted by the Environment Control Council are outlined. Inspections of feed lots and investigations of existing waste management systems are in progress. Also outlined is the educational program (including economic factors coordinated by county extension agents, consulting engineers and the DEC. Advised maintenance of present systems and future research needs are discussed in outline form. (Frantz - East Central).

### 1019-A2, A6, A7, B2, E2, F2

**PROBLEMS OF ANIMAL WASTE MANAGEMENT FROM THE LIVESTOCK FEEDER VIEWPOINT,**
*Chairman of the Environmental Management Committee of the Nebraska Livestock Feeders Association; Chairman of the Nebraska Feedlot Waste Control Advisory Committee.
W. Krejci.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 69-71, November 29-30, 1972.

Descriptors: *Feed lots, *Farm wastes, *Runoff, Odor, *Cattle, *Hogs, Lagoons, Surface waters, Nebraska, Air pollution, Legal aspects.
Identifiers: *Agricultural Research Service, Department of Environmental Control.

Livestock feeders have sacrificed some of their freedom for the improvement of the environment. Arguments and recommendations are considered from the feeders' viewpoint. Filtering runoff through fields is a suggested alternative to concentration of runoff into holding ponds. Also, swine wastes should be as much in governmental focus as are cattle waste problems. More extensive data will be required to control some feed lot runoff problems, but proper management and further governmental and educational cooperation will aid feeders. (Frantz - East Central).

### 1020-A2, A3, A4,A5, A6, A7, B1, B4, C2, E2, F3

**POLLUTION OF AIR, WATER AND SOIL BY LIVESTOCK,**
U.S. Department of Agriculture, Lincoln, Nebraska.
T. M. McCalla, and G. E. Schuman.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 75-78, November 29-30, 1972.

Descriptors: *Air pollution, *Water pollution, *Soil contamination, *Feed lots, Odor, Runoff, **Waste storage, *Waste treatment, *Waste disposal, Livestock, *Farm wastes, Nitrates, Groundwater.
Identifiers: *Abandoned feedlot reclamation.

Although researchers have solved many problems, they have uncovered many areas which require further research. A standard method for defining odorous compounds is needed. More reliable maintenance and sealants are needed to prevent seepage into ground water. Experiments in land disposal should be carried out for at least ten years to assure long range effects. (Frantz - East Central).

### 1021-A2, A4, A5, A8, B1, C1, C2, D1, E3, F6

**APPLICATION, UTILIZATION AND DISPOSAL OF LIVESTOCK WASTES,**
University of Nebraska, Lincoln, Agricultural Engineering Department.
O. E. Cross.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 83-89, November 29-30, 1972, 14 ref.

Descriptors: *Farm wastes, Feed lots, *Waste disposal, *Recycling, *Water pollution, *Application methods, Irrigation, *Soil management, Physical properties, Chemical properties, Runoff, Groundwater, Effluents, Nitrates, Centrifugation, Conductivity, Phytotoxicity, Cattle, Hens, Turkeys.
Identifiers: Micronutrients.

Research plans for fourteen projects are given. Research objectives and problems to be faced are discussed. Current problems include waste management, waste utilization, runoff control systems, effluent disposal and effects of disposal on agricultural land. (Frantz - East Central).

### 1022-A2, A6, B2, F6

**RESEARCH NEEDS FOR THE DESIGN AND MANAGEMENT OF BEEF FEEDLOT RUNOFF CONTROL SYSTEMS,**

Agricultural Research Service, Lincoln, Nebraska, U.S. Department of Agriculture.
N. P. Swanson.
Proceedings: Livestock Waste Management Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 93-97, November 29-30, 1972, 4 ref.

Descriptors: *Feed lot, *Waste disposal, Nebraska, *Farm wastes, *Pollutants, *Cattle, Gravity, Irrigation, *Runoff, Effluents, Infiltration.
Identifiers: Environmental Protection Agency, Buffer strips, Field disposal, Meat Animal Research Center, University of Nebraska Field Laboratory, Soil Conservation Service.

Current research should partially resolve feed lot runoff problems, but the goal is set for "zero pollution." New plans and objectives for overland flow, buffer strips, feed lot floor design and topographical research are discussed. These methods require researched proof of environmental acceptability. Proper distribution of effluent is of major concern to the Soil Conservation Service. Odor, because of nuisance suits, may be the greatest runoff problem. The facilities of the University Field Laboratory and Meat Animal Research Center is aiding research in several runoff control areas. (Frantz - East Central)

### 1023-A2, B2, C1, C2, C3, E1, F3

**CHARACTERISTICS OF LIVESTOCK WASTE AND RUNOFF,**

Agricultural Research Service, Lincoln, Nebraska, U.S. Department of Agriculture.
Proceedings: Livestock Waste Management Research Review, Nebraska Center of Continuing Education, Lincoln, Nebraska, p. 101-103, November 29-30, 1972, 29 ref.

Descriptors: *Farm wastes, *Physical properties, *Chemical properties, *Feed lots, Coliforms, Pathogenic bacteria, Lagoons, Management, *Waste disposal, Degradation, Runoff, Cattle.
Identifiers: *Catonic nutrients, Mounding, Microbial properties. /

Defining physical, chemical and microbial characteristics is basic to current and future farm waste disposal and runoff control. Three projects whose aims are determining physical and chemical properties in relation to the mechanics of waste disposal are discussed. Approximately three years will be required to complete needed research in these areas. (Frantz - East Central).

### 1024-A6, B2, B3, C2, E1, F3

**WASTE-INDUCED PROBLEMS OF HOUSED LIVESTOCK,**

U.S. Meat Animal Research Center, Agricultural Research Service, Clay Center, Nebraska, U.S. Department of Agriculture.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 107-110, November 29-30, 1972, 1 tab,

Descriptors: *Sheep, *Cattle, *Hogs, Nebraska, Recycling, Pollutants, Odor, Waste disposal, *Confinement pens, *Feed lots, Nutrients, Oxidation, Waste treatment, Transportation.
Identifiers: *Housed confinement, Meat Animal Research Center.

Although farm waste problems are in great need of research, livestock confinement provides numerous advantages: greater mechanization of chores, animal protection, and potentially increased production. Specific problems related to waste collection, treatment, transportation and disposal are listed in order to priority: odors, nutrient or chemical control or adjustment, treatment for reduction, land disposal, re-use, and system selection. Housed livestock research facilities at Nebraska's Meat Animal Research Center are described and possible research suggestions are listed. (Frantz - East Central).

### 1025-A2, B2, B3, E1, F3

**OTHER RESEARCH NEEDS,**

University of Nebraska, Department of Agricultural Engineering.
W. E. Splinter.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 113-114, November 29-30, 1972.

Descriptors: *Farm wastes, Proteins, Runoff, *Feed lots, *Waste disposal, *Recycling, Confinement pens, Aquatic animals, Hogs, Cattle, Filters, Nebraska.
Identifiers: *Paunch manure, Horses.

While needs are being met in many research fields, several areas will require increased attention. Alternate methods of recycling cattle manure, the use of grass as a runoff filter, and the treatment and disposal of swine, horse and aquatic wastes should further be explored. (Frantz - East Central).

### 1026-F6

**REGIONAL ADMINISTRATOR'S SUMMARY,**

Agricultural Research Service, North Central Region, Peoria, Illinois, U.S. Department of Agriculture.
T. B., Kinney, Jr.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 117-119, November 29-30, 1972.

Descriptors: *Farm wastes, Research.

The regional administrator encourages research efficiency by increased cooperation among state, federal and industrial groups. Research priorities must be justly established and sound research must be carried out on high priority problems. (Frantz - East Central).

### 1027-F3, F6

**REGIONAL ADMINISTRATOR'S SUMMARY,**

Agricultural Research Service, North Central Region, Peoria, Illinois, U.S. Department of Agriculture.
H. M. Tester.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Nebraska, p. 121-124, November 29-30, 1972.

Identifiers: *Program Planning Review.

Researchers should be required to do fewer reviews and reports that could be done through the Program Planning Review. The Program Planning Review plans and evaluates research programs and assesses the quality and effectiveness of research. (Frantz - East Central).

### 1028-F1, F6

**AREA DIRECTOR'S SUMMARY,**

'Agricultural Research Service, Clay Center, Nebraska, U.S. Department of Agriculture.
K. E. Gregory.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 125-126, November 29-30, 1972.

Descriptors: *Farm wastes, *Management, *Feed lots.
Identifiers: *U.S. Meat Animal Research Center, Agricultural Research Service.

High priority problems call for specific research approaches. Shortage of funds necessitates consolidation of some programs and reduction of others. Resources should be budgeted for efficient research at all locations. (Frantz - East Central).

### 1029-A6, A8, E1, F3, F6

**CONCLUDING COMMENTS,**

Agricultural Experiment Station, College of Agriculture, University of Nebraska, Lincoln.
H. W. Ottoson.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 127-129, November 29-30, 1972.

Descriptors: *Farm wastes, Crop production, Livestock, Soils, Marketing, Waste disposal, Odor, Feed lots, Confinement pens, Nebraska.
Identifiers: *Agricultural Research Service, Environmental Protection Agency, Land application.

The livestock waste management conference was a success. The conference was a bench mark inventory on which research in livestock waste management may be planned in the future. (Frantz - East Central)

### 1030-C2, D1, E3, F1

**RECOVERY OF ANIMAL FEED FROM CATTLE MANURE ,**

Northern Marketing and Nutrition Research Division, Agricultural Research Service, Peoria, Illinois, U.S. Department of Agriculture.
R. W. Jones, J. H. Sloneker, and G. E. Inglett.
Proceedings 18th Annual Institute of Environmental Sciences, p. 267-269, 3 tab., 17 ref.

Descriptors: *Recycling, *Farm wastes, *Cattle, *Feed lots, Waste disposal, Amino acids, Proteins, Filtration, Centrifugation, Illinois.
Identifiers: *Fractionating.

In the United States over 10 million tons of high grade protein are produced annually in cattle manure. Separating useful feed from fecal waste has become a valuable process which lowers feed costs and aids in waste disposal. Four methods for fractionating manure to remove undesirable constituents to produce high-protein feed supplement are described. Manure may be refined to remove the residue fraction, yielding a soluble fraction and a feed fraction that contains 64% of the original nitrogen. The feed fraction is higher in amino acid content than corn or wheat. The average steer annually produces $34 to $59 worth of feed fraction. Feed savings alone could be used to properly dispose of less usable waste fractions. (Frantz - East Central).

### 1031-A6, B3, C1, D1, E2, F1

**ELECTRIC IN-HOUSE DRYING OF POULTRY WASTE,**

Cornell University, Ithaca, New York, Department of Agricultural Engineering.
D. R. Price, A. T. Sobel, and H. R. Davis.
Paper presented at the 1972 Winter Meeting of the American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972. Paper No. 72-906, 12 p., 3 tab., 9 fig.

Descriptors: *Poultry, Odor, Nutrients, *Recycling, *Farm wastes, Physical properties, Moisture, Fertilizers, *Waste disposal.
Identifiers: New York, *In-house drying, High-rise poultry house, Circulating fans, Exhaust fans, Drying costs,

Forced air over manure removes water continuously in a high rise poultry house designed to house 30,000 caged birds. The drying process removes one-half of the wastes' total weight and reduces odor by minimizing bacterial activity. The dried manure is spread only once a year, thus recycling nutrients through cropland. Design figures for a high-rise poultry house and operation costs for the drying system are included. (Frantz - East Central).

### 1032- A6, A8, B2, E2, F6

**NEBRASKA IS NO. ONE,**
Calf News, p. 38-39, July, 1972, vol. 10, No. 7, 8 fig.

Descriptors: *Feed lots, Cattle, *Farm wastes, Odor, Irrigation, Laboratories, Percolation, Soil analysis, Nebraska.

Facilities of the Agricultural Research Service at the University of Nebraska were observed by CALF. A well equipped laboratory was found that supplies data which a computer stores and disseminates. Field sampling sites were examined. Runoff, air and water penetration into the soil, irrigation, and cattle breeding are only a few of the studies made through use of these facilities. (Wetherill - East Central).

### 1033-A4, A7, C2, D2, D3

**NITROGEN IN INDUSTRY,**
Ultimate Disposal Research Program, Advanced Waste Treatment Research Laboratory, Water Quality Office, Environmentaal Protection Agency, Cincinnati, Ohio.
J. B. Farrell,
Presented at symposium on Nitrogen in Soil and Water, Hespeler, Ontario, Canada, March 30-31, 1971, 14 p., 3 tab., 2 fig., 13 ref. (PB-213 731, N.T.I.S.).

Descriptors: *Nitrogen, *Industry, *Fertilizers, *Water pollution, Ammonia, Farm Animals, Urea, Activated carbon, Chlorination, Denitrification, Industrial wastes, Waste treatment, Air pollution.
Identifiers: Nitric acid.

The extent of water pollution from industrial and fertilizer production sources is examined. Nitrogen from industrial production represents only a portion of the nitrogen distributed to water. Nitrogen water pollution from industrial sources then is restricted to isolated point sources. Large tonnage processes produce nitrogenous effluents in gaseous forms thus causing air pollution and not water .pollution. Small tonnage production, however, can lead to large quantities of nitrogen lost. Recovery is impractical because of the economies involved in separating nitrogen from the wastes. Nitrogen may be removed biologically by changing nitrogen to ammonia or nitrates, then through chlorination, ion exchange, or $FeSO_4$ reduction can remove nitrogen entirely or convert it to a gas, (Marquard - East Central).

### 1034-C3, D2, F6

**TECHNIQUES FOR THE SAMPLING AND HANDLING OF ANAEROBIC MICROBES IN WASTE FERMENTATION SYSTEMS,**
University of Kentucky, Lexington, Agricultural Engineering Department, Baylor College of Medicine, Houston, Texas, Dermatology Department.
H. E. Hamilton, I. J. Ross, and S. W. Jackson.
Transactions of ASAE, Vol. 16, No. 1, p. 172-175, 1973, 9 fig., 4 ref.

Descriptors: *Autoclaves, *Farm wastes, *Poultry, Livestock, Anaerobic conditions, *Fermentation, Analytical techniques, Dilution.
Identifiers: Rumen sampling, Fermentor sampling, Test tubes, Pipetting device, Inoculation, Microbial growth, Colony counting, Chemical changes.

An equipment and technique experiment involved the fermentation of autoclaved chicken excreta with rumen microbes obtained from a fistulated steer being fed a diet containing 23% chicken manure. The equipment pictured and described was designed and constructed for improving the efficiency of preparing test tubes for enumerating microbes in the fermented samples. This equipment successfully aided in the experiments requiring rapid handling and processing of large numbers of samples. (Frantz - East Central).

### 1035-A8, E2

**IMPLICATIONS OF CROP-PRODUCTION TECHNOLOGY FOR ENVIRONMENTAL QUALITY,**
Illinois Univ., Urbana. Dept. of Agronomy.
S. R. Aldrich, W. R. Oschwald, and J. B. Fehrenbacher.
Environmental Geology Notes, Illinois State Geological Survey, No 46, p 7-24, May 1971. 8 fig, 6 tab, ref.

Descriptors: *Agriculture, *Environment, *Farm wastes, *Crop production, Farm management.
Identifiers: *Crop-production technology, Environmental quality.

Illinois is used as a model to examine some effects of technology on the environment. The effects of selected modern crop production technologies are examined, including the use of nitrogen and phosphorus as fertilizers. Recent restrictions on the use of certain production technologies and attacks on fertilizer use have led to analysis in greater detail of the possibilities for an consequences of producing crops with less use of available technology. Return to more primitive agricultural methods, however, is regarded as unwise. The justification for using each practice and subsystem of production must be challenged to insure the least undesirable impact on the environment. The utilization of the best available crop-production technology will likely meet the needs of society with the least harm to the environment. (Wray-Chicago)

### 1036-A2, A4, A5, A9, B2 B3, C3, D1, E2

**AGRICULTURE: THE UNSEEN FOE IN THE WAR ON POLLUTION,**
N. William Hines.
Cornell Law Review, Vol 55, p 740-760, 1970. 21 p, 111 ref.

Descriptors: *Agriculture, *Water pollution, *Pesticides, *Fertilizers, Chemicals, Farm wastes, Nitrogen compounds, Phosphorus compounds, Water pollution sources, Water pollution effects, Irrigation practices, Leaching, Confinement pens, Domestic wastes, Soil disposal fields, Waste disposal, Eutrophication, Waste assimilative capacity, Salinity, Saline soils, Salt tolerance, Sedimentation, Sediment Control, Soil conservation.

Agricultural wastes have received practically no attention in recent efforts to prevent and abate water pollution. Control of municipal and industrial wastes may be cancelled by failure to control the four major sources of agricultural pollution: animal wastes, chemicals, sediment, and salt. Pollution from animal wastes results primarily from the use of feed-lots to fatten beef. Feedlot runoff is high in oxygen demand, depleting oxygen supplies in streams; furthermore, the various nutrients in such wastes cause eutrophication. Pollution from feedlots may be controlled by treating drainage and disposing of accumulated solid wastes, although the latter solution has proved difficult. Both agricultural fertilizers and pesticides are major factors in water pollution. Fertilizer, through its chief nutrients--nitrogen and phosphorus--is also responsible for eutrophication. Moreover, use of fertilizer is virtually unregulated. Although pesticide usage is strictly regulated, present regulations are not directed towards water pollution. The potential harm of pesticides has not been thoroughly evaluated. Quantitat ively, sediment is the most serious agricultural water pollutant; inefficiency of soil conservation districts is primarily responsible. Excessive salinity affects agricultural productivity. Irrigation increases the problem, and an adequate solution has been evasive. (Hart-Florida)

### 1037-A4, A5, A8, E2

**NITROGEN IN AGRICULTURE: THE PROBLEMS AND THE EFFECT ON THE ENVIRONMENT,**
Edinburgh Univ. (Scotland).
Stephen Watson.
Advancement of Science, Vol 27, No 131, p 25-37, Sept 1970. 5 fig, 5 tab, 15 ref.

Descriptors: *Nitrogen, *Water pollution effects, *Land management, *Environmental effects, *Fertilizers, Ammonia, Nitrates, Ureas, Nitrogen fixation, Crop response, Nitrogen fixing bacteria, Nitrogen cycle, Legumes, Grasses, Proteins, Soil microorganisms, Sewage, Farm wastes.

About 80% of the world's human population utilizes only 20% of the world's available protein. The problem is not one of redistribution but of increasing protein supplies. World supplies of fixed N are divided into 60 million tons in animals, 1000 million in plants and 150,000 million in the soil. To this, 100 million tons are annually added by biological fixation and 10 million by industrial fixation. The production of N by soil microorganisms and the utilization of N by plants are reviewed in detail. The problem of proper pasture mixtures between grasses and legumes in combination with controlled grazing is considered and the phenomenon of increased N fertilizer application to grasslands is described. Combinations of legumes and grasses result in improved pastures and soil fertility but the process is too slow to rule out N fertilizer applications in combination with appropriate water applications. Field drying is a brittle process which may result in great protein loss unless carefully managed, particularly because of the high cost of evaporating water. The problem of water pollution due to increased N fertilizer application and intensified cattle feeding is considered in detail. Such pollution may be considerable, but will not be of the same order as that due to biological fixation, town sewage and industrial wastes. (Casey-Arizona)

### 1038-A3, A4, A9, C2, E1, E2

**CONCENTRATIONS OF POLLUTANTS IN AGRICULTURAL RUNOFF,**
Texas Tech. Univ., Lubbock. Dept. of Civil Engineering; and Texas Tech. Univ., Lubbock. Dept. of Chemistry.
Dan M. Wells, Ellis W. Huddleston, and Robert G. Rekers.
Partially supported by FWQA. Water Resources Bulletin, Vol 7, No 1, p 124-132, Feb 1971. 9 p, 3 tab.

Descriptors: *Lakes, *Water quality, *Texas, *Farm wastes, *Water pollution sources, Runoff, Nutrients, Solutes, Nitrates, Phosphates, Herbicides, Pesticides, Playas, Overland flow.
Identifiers: Agricultural runoff.

Eighteen rural lakes in Lubbock County, Texas, were sampled on a routine basis following runoff-producing rainfall for a period of approximately eighteen months to determine whether or not runoff from intensively farmed agricultural areas contained significant concentrations of nitrates, phosphates, herbicides, or insecticides. An additional fifteen lakes lying within a triangle bounded by the cities of Plainview, Canyon, and Hereford, Texas, were sampled one time during the summer of 1969 to provide additional data regarding the nature and extent of the potential problem in an area with a different soil type and a slightly different cropping pattern. Based on results of detailed analyses of approximately two hundred samples of water collected from the lakes and an equal number of sediment samples collected from the same lakes at the same time, it appears that the concentrations of all chemical pollutants in runoff from agricultural lands in the High Plains are well below the allowable concentrations for drinking water. (Knapp-USGS)

### 1039-A3, A4, C2

**NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON, OHIO,**
Agricultural Research Service, Beltsville, Md. Soils Lab.
A. W. Taylor, W. M. Edwards, and E. C. Simpson.
Water Resources Research, Vol 7, No 1, p 81-89, February 1971. 9 p, 3 fig, 6 tab.

Descriptors: *Nutrients, *Runoff, *Forests, *Farms, *Ohio, Nitrogen, Nitrates, Phosphates, Potassium, Data collections, Water quality, Path of pollutants, Eutrophication, Appalachian Mountain Region, Farm wastes, Statistical methods, Fertilizers, Leaching, Water pollution sources.
Identifiers: Woodlands, Farm lands, Coshocton (Ohio).

Nitrogen, phosphate, and potassium concentrations were measured in streams draining woodland and farmland watersheds at Coshocton, Ohio 1966 through 1969. Temporal variations in the nutrient concentrations were much smaller than the changes in the rate of streamflow. No relationship was found between any nutrient concentration and streamflow, and no seasonal changes in concentration were detected. Nutrient losses from farmland were significantly greater than those from woodland. The nitrate-N concentration in the farm runoff was below 2 ppm except for one short period when it rose to 10 ppm. The input of nitrogen in the rain was greater than the loss in runoff from both watersheds. The average concentration of phosphate in runoff was 22 ppb (of P) from the farm and 15 ppb from the woodland. The analysis of the data shows that total nutrient losses cannot be calculated meaningfully unless both hydrologic and chemical data are available. The volume of water flow is the most important variable in this calculation. (Knapp-USGS)

### 1040-B2, D3, F6

**STABILIZATION OF DAIRY WASTES BY ALGAL-BACTERIAL SYMBIOSIS IN OXIDATION PONDS,**
Alexandria Univ. (Egypt). High Inst. of Public Health.
F. M. El-Sharkawi, and S. K. Moawad.
Journal of the Water Pollution Control Federation, Vol 42, No 1, p 115-125, January 1970. 4 fig, 5 tab, 17 ref.

Descriptors: *Dairy industry, *Oxidation lagoons, *Pilot plants, Algae, Biochemical oxygen demand, Biological treatment, Photosynthesis, Stabilization, *Waste water treatment, *Farm wastes.
Identifiers: *Alexandria (Egypt), Pandorina, Soluble organic solids.

A pilot-plant study of BOD reduction of milk processing wastes is reported. A synthetic dairy waste of 750 mg/l BOD was fed continuously to rectangular concrete basins with sloping sides to minimize sludging. The detention period was 10 days. An influent pH of 9.8 was maintained to keep the pH at a level conducive to algal growth. Tank depth was important in maintaining balance between the algal and bacterial fractions of the system. The microflora showed plasticity in adapting to environmental variations. Pandorina constituted a major member of the flora highly adaptable to interaction with dairy wastes. Pandorina could tolerate wide temperature variations (11 deg to 32 deg C) at a constant depth of 75 cm. Other organisms were responsive to specific conditions and when the dominant groups suffered a serious setback, the subdominants flourished. Biochemical oxygen demand (BOD) reductions were 80 to 90 percent at a BOD loading rate of 220 lbs/acre/day (246 kg/dia/day). (Aguirre-Texas)

### 1041-A5, C2, E2

**STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS BENEATH URBAN AND AGRICULTURAL AREA-FRESNO, CALIFORNIA,**
Agricultural Research Service, Fresno, Calif. Groundwater Recharge Field Station.
Harry I. Nightingale.
Groundwater, Vol 8, No 1, p 22-28, Jan-Feb 1970. 7 p, 6 fig, 5 tab, 8 ref.

Descriptors: *Water pollution sources, *Groundwater, *California, *Nitrates, *Salinity, Water wells, Aquifers, Irrigation water, Fertilizers, Urbanization, Statistical methods, Surveys, Conductivity, Farm wastes, Regression analysis.
Identifiers: Fresno (Calif).

The salinity and nitrate content of well water for an urban zone (Fresno-Clovis, California) and the immediate surrounding irrigated agricultural zone were compared using data for 1930 through 1967. Time trends in these water chemical properties were evaluated statistically by dividing the 18-year period into three 6-year periods. Salinity of the urban zone groundwater has increased with time, whereas that of the agricultural zone has fluctuated considerably. Possible reasons for changes are discussed. The nitrate content of well water from both zones has increased with time, with water from the agricultural zone showing the greatest increase. (Knapp-USGS)

### 1042-A3, A4, E2, F2

**THE PROBLEM OF AGRICULTURAL POLLUTION IN WATER TREATMENT,**
Pawtucket Water Dept., R.I.
John A. McManus, and Albert A. Zalfa.
Journal of the New England Water Works Association, Vol. 83, No. 4, p 311-321, Dec. 1969. 11 p, 2 tab, 2 fig.

Descriptors: *Water pollution sources, *Animal wastes, *Fertilizers, Farm wastes, Water pollution treatment, Legal aspects.
Identifiers: *Pawtucket (Rhode Island).

The main concern of the Pawtucket, Rhode Island water supply system is the problem of pollution due to farmers using animal wastes for fertilizer. Due to the lack of large reservoir at the lowest end of the drainage basin feeding the treatment plant, the results of the animal wastes on the fields are severe at the point of treatment. The drainage and the seasonal usage of the water supply system are described: The pollution problem is in part attributed to one cattle company which hauled their waste material into the basin and deposited the solid and liquid wastes in great quantities. Because of the lack of dilution or detention time, high bacterial levels resulted. A schematic diagram of the water treatment plant is shown and its capabilities are described. The problem is that existing state law does not allow the prohibition of fertilizing agricultural land with animal wastes, even if such methods result in water pollution. (Grossman-Rutgers)

### 1043-A4, A5, A7, A8, A9, A11, A12, B1, C2, D3, F3, F6

**WASTES IN RELATION TO AGRICULTURE AND FORESTRY,**
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
Cecil H. Wadleigh.
Dep Agr Misc Publication No 1065, Mar 1968. 112 p, 1 fig, 4 tab, 139 ref, 4 append.

Descriptors: *Water pollution sources, *Water pollution effects, *Agriculture, *Forestry, Agricultural chemicals, Fertilizers, Pesticides, Farm wastes, Farm management, Organic wastes, Industrial wastes, Forest management, Sediment load, Microorganisms.
Identifiers: Farm and forestry wastes.

The sources and effects of wastes contributed to air, water, and soil by agricultural and forestry management practices are briefly discussed. The major waste categories considered are radioactivity, chemical air pollutants, airborne dusts, sediments, plant nutrients, inorganic chemicals, organic wastes, infectious agents, allergens, industrial and agricultural chemicals, and heat. A bibliography of 139 entries is included. Appendices discuss wastes adversely affecting agriculture and forestry, research on waste management, and problems in waste management needing more attention. (Knapp-USGS)

### 1044-A3, A5, A8, A12, B2, B3, E1, E2, F4

**EFFECT OF VARIOUS FACTORS ON MOVEMENT OF NITRATE NITROGEN IN SOIL PROFILES AND ON TRANSFORMATIONS OF SOIL NITROGEN,**
Wisconsin Univ., Madison.
R. J. Olsen.
Univ of Wisconsin, Water Resources Center, Report 1969. 79 p. OWRR B-004-Wis.

Descriptors: *Nitrification, *Soil nitrogen, *Public health, *Soil leaching, Groundwater, Soil profiles, Water table, Surface runoff, Farm wastes, Aerobic conditions, Incubation.
Identifiers: *Lake eutrophication, *Soil phosphorus, Alfalfa-bromegrass, Spring thaws, Fertilizer-nitrogen.

There is increasing evidence that agriculture is contributing to the increase in nitrate-nitrogen in streams, lakes, and domestic water supplies. High amounts of nitrate-nitrogen in water are a health hazard and contribute to lake eutrophication. Methods by which nitrogen may enter the water from agricultural sources include the leaching of nitrate-nitrogen through the soil profile to the water table and surface runoff, especially during spring thaws from manure applied to frozen soil during the winter. The data obtained from field experiments indicate that pollution of groundwater with nitrate-nitrogen can be limited by avoiding excessive rates of fertilizer nitrogen; providing a crop cover on the soil during the growing season; use of hay crops, such as alfalfa-bromegrass, in rotation with corn or other crops receiving fertilizer nitrogen; and not permitting unprotected manure to accumulate during the time of year when leaching can occur. Recovery of fertilizer nitrogen by three successive corn crops and as soil inorganic nitrogen following the last crop ranged from 72 to 88 percent. The average concentration of nitrate-nitrogen in the soil solution at the lowest profile depth sampled ranged from 14 ppm for virgin soils to 21 ppm for manure contaminated soils and to 33 ppm for cultivated soils. Rate of nitrification was directly related to the rate of manure application, presence of aerobic conditions, period of incubation, and soil phosphorus. The average recovery of nitrogen by chemical analysis of the soil receiving the higher manure rates after 37 weeks of incubation ranged from 24% for anaerobic conditions to 73 to 80 percent for the aerobic conditions. These data suggest that where animal manure is not to be used as a fertilizer, lagooning of the manure under anaerobic conditions may be an effective method of disposal with a minimum risk of water pollution. (Olsen-Univ of Wis)

### 1045-A3, A4

**AGRICULTURE'S CONTRIBUTION TO THE FERTILIZATION OF CANAL LAKE,**
Guelph Univ. (Ontario). Dept. of Soil Science.
F. R. Campbell, and L. R. Webber.
J Soil and Water Conserv, Vol 24, No 4, p 139-141, Aug 1969. 3 p, 2 fig, 2 tab, 9 ref.

Descriptors: *Eutrophication, *Nutrients, *Water pollution sources, *Agriculture, Nitrogen, Phosphorus, Fertilizers, Runoff, Farm wastes, Productivity, Aquatic plants.
Identifiers: *Canal Lake (Ontario).

Water quality, weed growth, and nutrient loadings of Canal Lake, Ontario were studied between May and November 1968. Relatively little nitrogen and phosphorus are contributed by the area's low-level agriculture. Precipitation contributes more nitrogen than streams. Agriculture contributes about 0.15 lb/acre, about a twentieth of the yield from an equivalent nonfertilized area. Most nitrogen probably comes from lake sediments, plants, and fixation of nitrogen in the lake. About 84% of the phosphorus probably originates in a lake upstream of Canal Lake. The agricultural yield is only about 63 lb from 30,000 acres. These contributions, of nutrients are negligible considering the total nutrients in the lake, the nutrient load of the streams and other sources of nutrients. (Knapp-USGS)

## 1046-B2, F1

**AN ECONOMIC ANALYSIS OF POULTRY PROCESSING WASTEWATER IN DELAWARE AND APPROPRIATE MUNICIPAL SEWER TAXATION,**
Delaware Univ., Newark. Dept. of Agricultural and Food Economics.
B. L. Hudson.
M. S. Thesis, June, 1970. 92 p, 28 fig, 4 tab, 40 ref, 3 append. OWRR B-003-DEL (3).

Descriptors: *Waste water (Pollution), *Economics, *Waste water treatment, *Poultry, *Water pollution sources, Biochemical oxygen demand, Industries, Delaware, Sewage districts, Taxes.
Identifiers: *Sewage assessments.

One important characteristic of the poultry processing industry is its high water usage rate. This characteristic has become cause for great concern among processors due to the newer and more rigid water pollution regulations of both the federal and state governments. Five of Delaware's six poultry processing plants were studied primarily to determine the sources of waste and wastewater. The general study procedure involved isolating and analyzing effluents from individual in-plant operations. The scalding, dressing, eviscerating, and chilling operations are the main sources of wastewater. The clean-up operation also produces sizable amounts of wastewater although precise measurements were unavailable. Average main effluent volumes per processed bird varied considerably between plants, ranging from 3.2 to 8.2 gallons. A case study of Milford, Delaware's wastewater treatment operations indicated that sewage assessments may take the form of (1) annual contributions by firms to the municipality, (2) cost-sharing payments for construction and maintenance, and (3) payments based on variable rates. Equity and efficiency considerations suggest, however, that a combination property-marginal cost tax system might be more desirable. (Settle-Wisconsin)

## 1048-A8, C2, C2, D3, E2

**SPRINKLER APPLICATION OF ANAEROBICALLY TREATED SWINE WASTES AS LIMITED BY NITROGEN CONCENTRATION,**
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. K. Koeliker.
Ph.D. Thesis, 1972. 203 p, 11 fig, 66 tab, 60 ref, 16 append. OWRR A-021-IA (6).

Descriptors: *Anaerobic conditions, Irrigation, *Chemical oxygen demand, Denitrification, *Nitrogen, Application rates, Phosphorus, Lagoons, *Farm wastes, *Wastewater treatment, *Water reuse, *Sprinkler irrigation, Soils, Hogs, Wastewater disposal, Sands, Clays.
Identifiers: *Swine wastes.

The effectiveness of soil as a final treatment and disposal system for anaerobically treated swine wastes was examined. Anaerobic lagoon effluent was applied to grass covered and tile drained field by sprinkler irrigation during the May-October season. Over a 3-year period, average concentrations in the tile drainage were 5-21 percent of the COD, 20-40 percent of the nitrogen and 1-10 percent of the phosphorus applied in the anaerobic lagoon effluent. In 4-ft. laboratory soil columns with soils ranging in texture from sand to silty clay loam, less than 10 percent, on a mass basis, of the nitrogen added in anaerobic lagoon effluent was lost; unless the soil became so waterlogged that at some time during a 45-wk. period it would no longer infiltrate the 2 inches/wk. applied. Addition of 20 tons/acre of oats straw as an energy source to the top six inches of half the columns did not improve nitrogen losses. All textures of soils removed more than 95 and 99.8 percent of the COD and phosphorus, respectively, from the percolate. Soil has a great potential to remove oxygen-demanding material (COD) and phosphorus from anaerobic lagoon effluent; however, its effectiveness as a final treatment system is limited by an inability to successfully remove nitrogen. Therefore, anaerobic lagoon effluent should be considered as a very dilute solution of liquid nitrogen and its application to soil restricted to rates that are consistent with the nitrogen requirements of crops grown on the disposal area. (Powell-Iowa State)

## 1049-A3, B2, C2, F1

**ECONOMICS OF WATER QUALITY MANAGEMENT: EXEMPLIFIED BY SPECIFIED POLLUTANTS IN AGRICULTURAL RUNOFF,**
Iowa State Univ., Ames.
J. J. Jacobs.
Ph.D. Thesis, 1972. 208 p, 5 fig, 58 tab, 129 ref, 2 append. OWRR B-015-IA (2).

Descriptors: Economics, Water quality control, Pollutants, *Agricultural runoff, *Sediments, *Phosphorus, Iowa, *Water management (Applied), Water pollution sources, *Cost analysis, Cultivation.
Identifiers: *Nishnabotna River Basin, Minimum tillage.

The role of economics in environmental quality management was analyzed, with particular reference to the optimal level of water quality in a selected use area. Sediment and phosphorus in agricultural runoff were the pollutants selected in depicting the role of economics in water quality management. The agricultural land in the Nishnabotna River Basin in Southwestern Iowa was the study area. This land was split up according to six capability classes, supplied by the Conservation Needs Inventory. These capability classes in combination with crop rotations, tillage methods and conservation practices are regarded as a cropping system. For each system the annual costs and returns in addition to sediment and phosphorus losses were estimated. With this information the minimum cost of achieving specified levels of water quality, i.e., sediment and phosphorus, were obtained. The study results point up the dominance of minimum tillage and continuous row crops in the optimal solutions. The results also indicate that the magnitude of the delivery ratio and the phosphorus constraints have a relatively small impact on the cost of the program. Furthermore, it was shown that the most stringent constraint could be met at an estimated cost of about $4.75 per acre with a delivery ratio of .25. While this cost does not appear to be unreasonable, comparing the control cost with the benefits to a municipal use indicates that this level of quality control can only be justified economically if there is a large reuse of the water (80-400:1) or substantial aesthetic benefits. (Powell-Iowa State)

## 1050-A4, A5, A7, A8, B1, F2

**THE LEGAL FUTURE: NEW THEORIES OF ENVIRONMENTAL PROTECTION,**
California Univ., Berkeley.
P. S. Berry.
In: Transcripts of the Speeches, National Conference on Environmental Law, p 183-207, November 1970. 25 p.

Descriptors: *Environmental sanitation, *Remedies, *Legislation, *Pollution abatement, Natural resources, Resource allocation, Environmental effects, Conservation, Water pollution, Water pollution control, Air pollution, Federal government, State governments, Administrative agencies, Government finance, Industries, Forest management, Oil industry, Livestock, Mining, Lumbering, Land management, Taxes, Decision making, Legal aspects.
Identifiers: National Environmental Protection Act.

Historical approaches to conserving natural resources through statutory and common law means provide solely remedial measures. Recent trends in tort law evidence stronger methods of environmental protection. This has been achieved by broadening the concept of causation and imaginative applications of the public trust doctrine. Comprehensive protection of the environment may result from either a constitutional amendment creating a new civil liberty or stronger state statutes. The 1970 Michigan Environmental Protection Act is discussed, with emphasis upon what this new legislation will accomplish. The National Environmental Policy Act is criticized for its failure to prohibit ecologically unsound activities. The concept of corporate responsibility for private industry is discussed, and the traditional polarity between the private profit motive and national environmental preservation is considered. Environmental solutions must alter the basic nature of private industry. Possible means of attaining this include: (1) national law, (2) state law, and (3) voluntary charter amendment. Proposals are suggested for revising taxation objectives. The Public Land Law Review Commission's Report is criticized, and alternatives to its findings are proposed. (Rees-Florida)

## 1051-A4, B2, C2, C3, E1

**POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES.**
Washington Univ., Seattle. Water and Air Resources Div.

Water and Sewage Works, Vol. 117, No. 18, p 291-297, August 1970. 6 fig, 3 tab, 15 ref.

Descriptors: *Fish hatcheries, *Salmonids, *Water pollution sources, *Biochemical oxygen demand, *Dissolved oxygen, *Hydrogen ion concentration, *Ammonia, *Nitrates, *Phosphates, *Solid wastes, *Animal wastes (Wildlife), Water pollution control, Food abundance, Chemical oxygen demand, Pathogenic bacteria, Animal parasites, Silts.
Identifiers: *Feces, Drugs.

The water pollution potential of salmonid hatchery operations was studied by surveying the literature, by questionnaire surveys, and by field tests. The study began in February 1969, and ended in February 1970. Pollution problems reported to be associated with fish hatchery operations included nutritional enrichment, algae and weed growth, taste and odor, settleable solids, pathogenic bacteria and parasites organic matter, chemicals and drugs. The literature review produced no positive results. The questionnaire survey revealed that 13 of 46 hatcheries responding indicated that they have had pollution problems. Field tests were conducted at the Green River Salmon Hatchery and the Kowlitz Trout Hatchery in the state of Washington to determine COD, BOD, and DO, pH, ammonia, nitrate, phosphate, suspended solids, dissolved solids, settleable solids, total solids, and total volatile solids. It was determined that the greatest pollution occurred during pond cleanout, and the most prevalent pollutants were fish fecal wastes and residual food. The result of the discharge of these pollutants was that: (1) the dissolved oxygen level was lowered in the effluent, (2) nutrient pollutants (Nitrate and phosphate) resulting from decomposition of fish food were increased, (3) solid pollutants both dissolved and settleable were significantly increased. It was further found that there were relationships between pollutant production rates, feeding rates, fish size, loading densities, and water supply rates. (Little-Battelle)

### 1052-A4, A5, A8, E2, F6

**EFFECT OF ANIMAL WASTES APPLIED TO SOILS ON SURFACE AND GROUND WATER SYSTEMS,**
Maine Univ., Orono. Dept. of Soil Sciences.
F. E. Hutchinson, R. A. Hoffman, and R. F. Jeffrey.
Maine Water Resources Research Center, Orono, Project Completion Report, September 1972. 38 p, 8 fig, 21 tab. OWRR A-020-ME (1).

Descriptors: *Water pollution sources, *Groundwater, *Farm wastes, *Nitrogen, *Maine, On-site investigations, Analytical techniques, Poultry, Path of pollutants, Soil properties, Rates of application, Infiltration rates, Data collections.
Identifiers: *Poultry manure.

This research project was conducted in Maine to determine the maximum acceptable rates of application of manure in: (1) excessively drained glacial outwash, (2) well drained glacial till and (3) poorly drained Maine soils, using field plots and a lysimeter study. Periodic analyses of soil, soil water and groundwater samples from a Windsor loamy sand treated annually for two years with poultry manure at nitrogen rates up to 1400 pounds per acre. Results indicate that mineralization of N occurred rapidly and that nitrate content of the subsoil just above the groundwater became high at times at rates above 350 pounds of nitrogen per acre. Nitrogen did not move downslope in any form at the top of the fragipan in a Charlton fine sandy loam beyond a distance of 20 feet on a 10 percent slope below plots treated with rates of N up to 1400 pounds per acre for two consecutive years. When nitrogen in poultry manure was applied to a poorly drained Scantic silt loam, an unacceptable amount of nitrate N moved through the profile into the free water table from applications greater than 200 pounds of N per acre. (Woodard-USGS)

### 1053-A4, C3, F6

**BACTERIOLOGICAL WATER QUALITY ANALYSES OF METHODS FOR DETECTING FECAL POLLUTION,**
South Dakota State Univ., Brookings.
Paul R. Middaugh.
Completion Report April, 1970. 14 p. OWRR Project A-019-S DAK (1).

Descriptors: Water pollution sources, *Farm wastes, Bacteria E.coli, Coliforms, Pathogenic bacteria, *Sewage bacteria, E coli, Enteric bacteria, Streptococcus bovis, Streptococcus faecalis, *Pollutant identification.

The initial or laboratory research phase of objectives were achieved. These were to improve the specificity, speed and reliability to bacteriological methods for determinging kinds and number of fecal bacteria in water resources. The major objective of distinguishing between human and animal sources of pollution was partially achieved by improved isolation of the rumen organism Streptococcus bovis. The objective of determining the survival of selected fecal coliform and fecal streptococcus in river water with and without filtration was completed in the M.S. Thesis study by Joseph Zerfas. He compared river water in laboratory flasks with environmental river exposure chambers to determine survival effect of temperature from 10 to 30C, decreased both coliform and streptococci equally with increased temperature. Added organic nitrogen fertilization of river from normal level 2.5 ppm N to 10 to 30 ppm N stimulated growth and lengthened survival time. Both kinds of organisms increased in survival in water with reduced dissolved oxygen compared to aerated water. In untreated river water fecal coliform bacteria lived longer than fecal streptococci, 7% and 0.1% survival respectively after 7 days. Water membrane filtered to remove protozoa gave 20% coliform and 100% streptococcus survival after 7 days. In M.S. Thesis study by L. Koupal, methods for detecting the rumen organism Streptococcus bovis resulted in a rapid, sensitive selective method using membrane filter for quantitative recovery from river water and selective medium incubated in 25% CO2+75% N2 gas grows S. bovis which is then detected by starch agar overlay. Only ruminants have S. bovis in numbers in feces so S. bovis in river survival studies was proven to be a useful tracer for ruminant pollution of surface waters. More rapid and sensitive methods for both indicator and pathogenic bacteria were being investigated when the project was terminated.

### 1054-A2, B2, B4, C1, C2, D3, F6

**APPLICATION OF SEWAGE TREATMENT TECHNIQUES TO FEEDLOT RUNOFF,**
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
T. McGhee, and R. L. Torrens.
Paper presented at the 16th Annual Great Plains Waste Water Design Conference, Omaha, Nebraska, March 28, 1972. 18 p, 4 fig, 5 tab, 13 ref. OWRR-A-022-NEB (1).

Descriptors: *Biological treatment, *Farm wastes, Feed lots, Cattle, *Waste water treatment, Biochemical oxygen demand, *Agricultural runoff, *Chemical oxygen demand, *Sewage treatment, *Aerobic treatment.

Laboratory studies of the aerobic treatment of feedlot runoff were conducted to determine the effect of such handling upon waste characteristics and the design parameters required for such treatment. Liquid retention times (organic loading rate) and biological solids concentrations were varied. Studies of the application of the BOD test to this waste were also conducted. Liquid retention times in the laboratory system varied from one to eight days. The conclusions were: (1) An aerobic system can effectively treat this waste with COD reductions of 60 percent or more. (2) Retention times of three days or more are adequate to insure treatment of solids concentrations (MLSS) of 2080 mg/L. (3) The color of the runoff is affected only slightly by such treatment. (4) COD analysis is superior to BOD analysis in measuring the strength of this waste.

### 1055-A4, A5, A9, C1, C2, F6

**ANNUAL REPORT OF ACTIVITIES DURING FISCAL YEAR 1971.**
Maine Univ., Bangor. Water Resources Center.
Annual Report No 7, 1971. 18 p, 3 append. OWRR A-999-ME (7).

Descriptors: *Water resources, *Water users, *Planning, *Projects, Legal aspects, Bottom sediments, Geochemistry, Hydrology, Coniferous forests, Rivers, Lakes, Biochemical oxygen demand, Dissolved oxygen, Management, Livestock wastes, Water quality, Education, Eutrophication, Phosphates, Water pollution control, Chlorinated hydrocarbon pesticides, Model studies, Tubificids, Physicochemical properties, Gases, Political aspects, Attitudes, Environment.

The research program conducted under the auspices of the University of Maine's Water Resources Center to solve Maine's water problems are described. Twelve projects explored the following areas: Hydrologic relationships in a coniferous forest; An investigation of the causes, effects, and control of eutrophication in Maine lakes; Phosphate retention by lake sediments; Geochemical cycles involving flora, lake water, and bottom sediments; Legal aspects of water pollution control through implementation of the effluent charge concept; Effect of animal wastes applied to soils on surface and ground water systems; The effects of DDT and other chlorinated hydrocarbons on the growth of euryhaline microalgae; Phase III--Study of a river system as a chemical reactor; Effects of burrowing tubificid worms on the exchange of phosphorus between lake sediments and overlying water; A study of the physico-chemical parameters affecting the removal of colloidal particles from water by porous media; Dissolved pollution product gases in natural waters; and Political and environmental attitudes of voters and public officials related to alternative levels of water quality and correlated alternative systems of management of the Penobscot River. The Center's researchers extend their findings to users in an active coordination, information, education, and training program. (Auen-Wisconsin)

### 1056-B1, F1, F4, F6

**AN ANALYSIS OF THE ECONOMIC IMPLICATIONS OF THE PERMIT SYSTEM OF WATER ALLOCATION,**
Iowa State Water Resources Research Inst., Ames.
N. E. Harl, R. A. Baldwin, and D. W. Hubly.
Iowa Water Resources Research Institute, Ames, Completion Report ISWRRI-43, November 1971. 261 p, 7 fig, 27 tab, 122 ref, 8 append. OWRR B-009-IA (2).

Descriptors: *Permit system, Economic efficiency, Water quality, Water resource investment, *Iowa, *Model studies, *Cost analysis, *Water allocation (Policy), Competing uses, Legal aspects, *Linear programming, Cost allocation, Evaluation.

The study contains three parts. In Part I, the literature of water allocation is reviewed and the permit system of administrative allocation is analyzed in terms of rational guidelines for allocating water as a scarce resource among competing alternatives. Special attention was given to the Iowa permit system, with the conclusion that the system acknowledges only two consistently identified points on a water user's production function (1) the point of zero output and zero water use, and (2) the point of maximum total product where the marginal physical product becomes zero. The system guidelines are insufficient for allocating water on efficiency bases if supply is limited and maximum physical productivity from water as a variable input is unattainable. In an effort to generate information about water productivities, to the end that additional points on the production function might be identified administratively as permits are granted under conditions of limited water supply in a particular area, a general model is constructed in Part II using a linear programming approach to resource allocation within an identified hydrologic area. In Part III, the general model was extended and refined to include detailed water quality considerations using both linear programming and simulation. The resulting Tandem Program Systems (TPS) Model makes possible cost adjustments in producing activities based upon the character of the wastes produced thereby, the assimilative nature of the stream and the treatment costs for maintaining a pre-determined level of water quality in the stream. Data from both the general model and the TPS model are presented. (Powell-Iowa State)

## 1057-A2, A3, A4, A11

### EFFECTS OF POLLUTION, ESPECIALLY FROM FEEDLOTS, ON FISHES IN THE UPPER NEOSHO RIVER BASIN,

Kansas State Univ., Manhattan. Water Resources Research Inst.
F. B. Cross, and L. M. Cavin.
Completion Report 1971; 50 p, 6 fig, 7 tab, 16 ref. OWRR A-026-KAN (1).

Descriptors: *Fishkill, *Water pollution effects, Sampling, Habitats.
Identifiers: *Feedlot pollution, *Upper Neosho River Basin, Nocomis asper, Notropis rubellus, Noturus nocturnus, Notorus placidus, Notropis lutrensis, Notropis camurus.

In spring, summer, and early autumn, 1969 and 1970, a total of 49 collections of fish were made at 17 localities in the upper Neosho River Basin: Fifty-three species were recorded, approximately as many as were known from the same area prior to severe drought in the early 1950's, establishment of three mainstream impoundments in the 1960's, and severe pollution from feedlots in 1966-67. Species lists were not identical to those obtained in similar but less intensive surveys in 1952 and 1967. Changes in species composition are attributable partly to effects of impoundment (including introductions of some species) and partly to organic enrichment. Diversity indices are being determined for each collection, allowing comparisons among samples from the same site on different dates, between years, and among localities throughout the area. Three species known to have occupied these streams in the 1950's were not found in 1969 or 1970: the recently-described redspot chub, Nocomis asper, Lachner and Jenkins, 1971; the rosyface shiner, Notropis rubellus; and the freckled madtom, Noturus nocturnus. Several additional species were found only rarely in 1969-70, including the Neosho madtom, Noturus placidus, the only species endemic to the Neosho basin. These four and others affected adversely are characteristic of clear, well-oxygenated streams having clean gravel riffles; their depletion is most logically attributable to effects of pollution. The two species selected for detailed study, with respect to differential trends in their populations associated with the period of organic pollution, were the red shiner, Notropis lutrensis, and the bluntface shiner, Notropis camurus. The red shiner became more abundant and more widespread within the streams studied, following fish-kills in 1966-67. Its increase seemingly occurred at the expense of the bluntface shiner, its nearest relative in the Neosho fauna. Apart from the advantage of comparing closely-related species, the bluntface shiner was chosen as the 'pollution intolerant' form because other species fitting that description were not obtained in numbers adequate for the kinds of comparisons desired. The comparative study involved habitats occupied and relative abundance; population structure and growth rates; reproductive requirements, fecundity, and spawning period; and response to reduced oxygen concentrations (routine metabolism, behavior under oxygen stress, loss of equilibrium, and capacity for recovery from temporary stress).

## 1058-A2, A4, C2, E2, F6

### DEVELOPMENT OF A MATHEMATICAL MODEL TO PREDICT THE ROLE OF SURFACE RUNOFF AND GROUNDWATER FLOW IN OVERFERTILIZATION OF SURFACE WATERS,

Minnesota Univ., Minneapolis. Water Resources Research Center.
Jack D. Johnson, and C. P. Straub.
Minnesota Water Resources Research Center, Minneapolis, WRRC Bulletin 35, June, 1971, 176 p, 58 fig, 65 tab, 78 ref, 4 append. OWRR Project B-012-MINN (1).

Descriptors: *Mathematical models, *Watersheds (Basins), *Nutrients, Nitrogen, Phosphorus, Streamflow, Sewage treatment, Effluents, Annual wastes, Fertilizers, Precipitation (Atmospheric), Soils, Water pollution sources, Model studies, Minnesota, Snowmelt, Treatment facilities, Nitrogen fixation, Denitrification.
Identifiers: *Manure spreading, *Spring runoff, Depletion processes, Nitrogen transformation, Agricultural practices, Feedlot drainage, New Prague (Minn).

A nutrient enrichment accounting mathematical model was devised for the New Prague watershed in Minnesota. The New Prague watershed is 23.3 square miles in area and is predominately a rural watershed. Model input data was collected over a 2 1/2-year period from a stream gaging station and two automatic sampling stations. Over 800 water samples were analyzed. Extensive effort was placed on better understanding the nitrogen and phosphorus cycles. It is evident that the spring runoff process and accumulative winter fertilizer applications constitute the major portion of diffuse sources of nutrients in the watershed. Point sources from feedlots and municipal and industrial effluents contribute only 11 percent of the sigma N (total nitrogen, four components) and 7 percent TP (total phosphorus). Disperse sources accounted for 89 percent of sigma N and 93 percent of TP, with spring runoff in the two months of Merch and April accounting for 79 percent of the annual sigma N and 64 percent of the TP. The nutrient output from the watershed could be decreased by increasing penetration of the large amounts of sigma N and TP in snowpacks into the soil through land terracing to retart rapid spring runoffs and sub-surface drains to allow rapid drainage during the crop season.

## 1059-A5, B1, C2

### NITRATE ACCUMULATION IN KANSAS GROUNDWATER,

Kansas Water Resources Research Inst., Manhattan.
Larry S. Murphy, and Jay W. Gosch. Project Completion Report, March 1970. 56 p, 13 tab, 19 fig, 38 ref. OWRR Project A-016-KAN.

Descriptors: *Nitrates, *Groundwater, Fertilization, Irrigation, Nitrogen, Farm wastes, Fertilizers, Ammonium compounds, Water pollution sources.
Identifiers: *Nitrate movement, Feedlots.

A study of nitrate-nitrogen accumulation in soils underlying feedlots in Kansas revealed accumulations of as high as 5000 kg/ha in a 4 meter soil profile. Age of the feedlots was found to be directly related to the amount of nitrate-nitrogen which had accumulated in the soil. Vertical movement of nitrate-nitrogen in feedlot soils had occurred even in areas of low rainfall (40-45 cm per annum). Large accumulations of ammonium-nitrogen but no nitrate-nitrogen were noted in a feedlot soil with a very low cation exchange capacity. Analyses of groundwater at that location were inconclusive in relating lack of nitrate-nitrogen in the soil profile with higher levels of nitrate-nitrogen in shallow aquifers. An investigation of the effects of high rates of applied inorganic nitrogen on nitrate-nitrogen accumulations in soil and groundwater was conducted azt two locations. Downward movement of nitrate-nitrogen under irrigated conditions was detected by deep soil sampling (5-6 meters) and comparisons of nitrate-nitrogen concentration peaks in the soil profile. Much variation in the amount of nitrate-nitrogen in the soil profile was noted even with uniform rates of nitrogen application. Investigation of nitrate-nitrogen accumulation in groundwater by means of check wells in the areas receiving large amounts of inórganic nitrogen revealed large fluctuations in the nitrate-nitrogen content over the life of the study but did not produce indications of definite trends. (McKenna-Kansas)

## 1060-A4, F2

### FOULING OF WATERS A MISDEMEANOR.

North Dakota Century Code Ann secs 61-01-12 thru 61-01-14 as amended (Supp 1969).

Descriptors: *North Dakota, *Water pollution sources, *Water pollution control, *Waste disposal, Water quality, Water quality control, Wastes, Industrial wastes, Refuse, Sewage effluents, Gasoline, Oil wastes, Farm wastes, Cattle, Sheep, Hogs, Sewage disposal, Streams, Rivers, Public health, Administrative agencies.

Section 61-01-12 provides that the fouling of public waters by depositing gas tars or other refuse from any gas house into streams, rivers or sewers that empty into public waters is a misdemeanor. Section 61-01-13 provides the fouling of public waters with dead animals, offal, or other refuse by depositing same on the banks or in any lake or stream within the jurisdiction of the state is a misdemeanor punishable by a fine of from $20 to $100. Section 61-01-14 provides that section 61-01-13 shall be construed to include: (1) privies and privy vaults; (2) any stable, shed, pen, yard, or corral where farm animals are located within sixty feet of the top of any lake or stream; and (3) any slaughterhouse, graveyard or cemetery within eighty feet of these waters. However, in an emergency, these provisions do not prevent any municipality from dumping untreated sewage into these waters provided they are not determined detrimental to public health. (Rees-Florida)

## 1061-A4, E1, F2

### RULES FOR CONFINED FEEDING OPERATIONS WASTE WATER DISPOSAL.

Iowa Water Pollution Control Commission, Des Moines.

1969. 3 p.

Descriptors: *Iowa, *Farm wastes, *Livestock, *Confinement pens, *Water pollution sources, Cattle, Treatment facilities, Water pollution, Waste disposal, Waste water treatment, Water pollution control, Regulation, Permits, State governments, Administrative agencies, Legislation, Legal aspects, Poultry, Organic wastes, Adoption of practices, Waste water disposal.

Confined feeding operations for livestock and poultry in which potential pollution may exist and be subject to regulation are defined as a cattle feedlot or several cattle enclosures on a single property containing at least one hundred cattle and an animal population of greater than one animal for each six hundred square feet. Registration of the operation is required where one or more of the following conditions exist: (1) the number of cattle confined exceeds a thousand head, (2) the feedlot contributes to a watercourse draining a specified acreage of land above the lot, and (3) the runoff water from a feedlot flows into a buried conduit or well. Persons engaged in or intending to initiate livestock operations shall register such operation with the Water Pollution Control Commission. If the State Department of Health determines that an operation does not constitute a water pollution problem, provisions for control facilities will not be required. If an operation is polluting state waters, the operator shall obtain a permit for waste water disposal and shall provide necessary water pollution control facilities. Requirements for such facilities are specified. Such facilities shall be operated so as to prevent water pollution. (Shelnut-Florida)

## 1062-A11, B3, C2, D2, E3

### CONTINUED RECYCLING OF CATTLE MANURE,

University of California, Davis.
C. L. Ferrell, and W. R. Garrett.

Proceedings, Western Section, American Society of Animal Science, Vol. 24, p. 415-419, 1973, 5 tab., 5 ref.

Descriptors: *Cattle, *Farm wastes, *Recycling, Nitrogen, Calcium, Nutrient Requirements;, *Waste disposal, California.
Identifiers: *Ration, Digestion stalls, Forced air ovens, Digestibility.

Four Hereford steers were confined in digestion stalls and fed the basal ration at a maintenance level. Their manure and urine were recycled in forced air ovens at 100°C. for 48 hours. The recycled wastes were mixed, digested, then recycled again. It was found that the less digestible components of the feces increased while digestible components decreased substantially during each recycling. Less energy was digested in subsequent refeeding. Mineral and nitrogen content increased with each recycling, resulting in the only significant nutritional value of manure after recycling. (Frantz - East Central),

## 1063-A4, A5, A8, C2, E2

### AGRICULTURE AND ENVIRONMENT,

W. H. Garman.
Crops & Soils, Vol. 25, No. 9, p. 14-19, Aug.-Sept., 1973.

Descriptors: *Photosynthesis, *Water pollution, *Nitrates, Phosphates, Soils, Eutrophication, *Livestock, Agriculture, *Farm wastes, Farm animals, *Fertilizers, Feed lots, Algae, Plankton, Nutrients, Carbon dioxide, Wells, Lakes, Balance of nature.

Questions regarding agriculture and the balance of nature are answered. The use of nitrogen fertilizers can under some circumstances be harmful to farm animals, but has never presented a human health problem. Farming and nitrate fertilizers seldom, except under extreme circumstances, contribute to nitrate levels in streams, lakes, and water wells. Fertilizers seldom cause excessive algae growth. Long term experiments show that fertilizer use has not damaged soils. (Frantz - East Central).

## 1064-A9, A10, D2

### TOXICITY TO HOUSE FLIES AND HORN FLIES OF MANURE FROM INSECTICIDE FED CATTLE,

Entomology Research Division, Agricultural Research Service, Kerrville, Texas, U. S. Department of Agriculture.
R. O. Drummond.
Journal of Economic Entomology, Vol. 56, No. 3, p. 344-347, June, 1963, 2 tab., 6 ref.

Descriptors: *Toxicity, *Farm wastes, Feed lots, Larvae', *Insecticides.
Identifiers: *House flies (Musca domestica), *Horn flies (Hacmatobia irritans) Bayer 22408, Butonate, Bayer 37342, Famophos, Bayer 37341, Thodia IP 9895, Dipterex, V-C 13, General Chemical 1072, Bayer 29493, Stauffer P-1504, Chlorinated hydrocarbons, U.S. Department of Agriculture Animal Disease and Parasite Research Division.

Insecticides were added to cattle rations on long and short term experiments. In a 91-day test Co-ral and Bayer 22408 proved 100% effective in preventing development of larvae of horn flies and partially effective against house flies in the manure tested. Ten insecticides were used in 10-day tests. Some insecticides were effective against both species, while others were at least partially effective with either or both. (Frantz - East Central)

## 1065-A8, B2, D3, E2

### EFFECTS OF SWINE LAGOON EFFLUENT OF THE SOIL AND PLANT TISSUE,

Iowa State University, Ames, Department of Agricultural Engineering; Department of Agricultural Engineering; and Department of Agronomy, respectively.
C. V. Booram, T. E. Hazen, and L. R. Frederick.
Presented at 1973 Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, Kentucky, June 17-20, 1973, 19 p., 17 tab., 1 fig., 16 ref.

Descriptors: *Hogs, Cattle, Iowa, *Farm wastes, Confinement pens, *Lagoons, Anaerobic conditions, *Effluents, *Nutrients, Electrical conductance, Salts, *Waste disposal, *Irrigation, *Toxicity, *Water pollution, Corn (field), *Soil contamination, Water quality.
Identifiers: *Clarion-Webster Soil, Tile-drained grass plots, Plant tissues.

Twelve 40 x 60 feet tile drained plots of Clarion-Webster soil were given applications of anaerobic lagoon effluent. The soil received 0, 3.7, 11.3, and 22.6 inches of effluent per season. There were no significant plant population differences at the 0.10 level. Corn tissues were analyzed for 14 nutrients. (N,P,K,Mg,Ca, Na, Si, Mn, Fe, Cu, Zn, Al, Sr, and Mo). In the tissue analysis P, Na, Fe and Al increased while Mg content decreased with increasing applications of effluent. After 4 years of anaerobic lagoon effluent applications the electrical conductivity of the soil showed little change, (Frantz - East Central).

## 1066-A3, A4, B2, C2, C3, E1, E2

### WATER POLLUTION BY SWINE PRODUCTION OPERATIONS,

University of Missouri, Columbia, Department of Agricultural Engineering.
J. Robbins.
PH. D. Thesis, North Carolina State University, Department of Biological and Agricultural Engineering, 1970, 440 p., 48 tab., 51 fig., 57 ref.

Discriptors: *Effluent, *Waste disposal, Hydrographs, *Hogs, North Carolina, Nutrients, Lagoons, Soils, Runoff, Influent, Bacteria, Surface waters, *Water pollution, Drainage, Streams, *Farm wastes, Hydrologic systems, Sampling, Biochemical exygen demand, Nitrogen, Phosphates, Biodegradation.
Identifiers: *Organic carbon.

Seven swine production operations, three using lagoons, one direct discharge, two land disposal, and one control watershed were studied to determine the extent of effluent contribution to stream pollution. Data were collected to determine the effluent strength to be discharged into streams. An analysis was made for more than 1000 effluent and stream samples. An organic carbon analysis was successful in determining strengths of wastes and waste waters. The biochemical oxygen demand (BOD)/total organic carbon (TOC) ratio provided an indication of the ease of biodegradation and/or the degree of stabilization. It was found that anaerobic lagoons are not satisfactory as the sole means of treating hog wastes. Direct discharge of wastes into water creates gross pollution and should be prohibited. Land disposal was found to be the superior method for protecting water quality, Slope, degree of erosion, and drainage patterns are the important factors in determining the quality of streams draining agricultural basins. (Frantz-East Central).

## 1067-A6, A7, B4, C2, E2, F6

### ANALYSIS OF ANIMAL WASTE STORAGE AND LAND DISPOSAL SYSTEMS,

R. Nordstedt.
PH. D. Dissertation, Ohio State University, Department of Agricultural Engineering, 1969, 101 p., 25 tab., 17 fig., 23 ref.

Descriptors: *Farm wastes, Odor, *Waste disposal, *Waste storage, Air pollution, Livestock, Feed lots, Fertilizers, Nutrients, Nitrates, Effluent, Diffusion.
Identifiers: *Scheduling model.

Systems which interact with storage and land disposal of farm wastes were analyzed and relevant interfaces and variables were identified. A mathematical model describing storage of wastes and their timely disposal on agriculture land was developed and tested. Odor nuisance potential of farm wastes spread on land was also deliniated. A scheduling model was developed. It could be an effective tool in the design and operation of waste storage and land disposal systems. The model takes into account all important system variables. The waste storage facility was the most significant investment, based on results of the scheduling study. Nutrient effectiveness as a function and land availability were significant. The pattern of the latter was a critical factor in determining minimum storage capacity. (Frantz - East Central).

## 1068-B3, C2, D2, E3, F1, F2

### NEW FEEDLOT CONCEPT USES CONVERTED MANURE AS FEED,

T. Zurowski.
Feedlot Management, Vol. 15, No. 8,, p. 26, Aug., 1973, 1 fig.

Descriptors: *Recycling, *Farm wastes, *Cattle, *Feed lots, *Nutrients, *Feeds, Economics, Bacteria.
Identifiers: *Refeeding,, Cowmel, Farm Ecology Company, Food and Drug Administration, *Cowdominium.

A Washington operation, Farm Ecology, has made plans for a cowdominium. This is a feed storage and a waste conversion plant. There the wastes are subjected to heat, pressure and either acidic or alkaline chemicals. The recycled product, Cowmel, is a highly nutritious and finely ground pellet. Economic feasibility and FDA approval is presently uncertain. (Frantz - East Central).

## 1069-A8, C2, E2

### MANURING OF POTATOES ON FEN SILT SOILS IN HOLLAND, LINCOLNSHIRE,

Agricultural Development an dAdvisory Ser'vice. Cambridge; Rothamsted Experimental Station.
C Berryman, T. Baley, T. H. Caldwell, and D. A. Boyd.
Journal of Agricultural Science, Vol. 80, p. 269-281, April, 1973, 12 tab., 1 fig., 17 ref.

Descriptors: *Silts, *Fertilizers, *Potatoes, Nitrogen, Phosphorus, Potassium, *England, *Nutrients, Drainage, *Farm wastes, *Waste disposal, Soil profiles.
Identifiers: *Tuber blackening.

Eighteen potato manurial experiments were conducted on silt soils in England between 1953 and 1963. The mean response to nitrogen in these soils was much larger than in most English soils, but responses were varied from site to site. The nitrogen was effective in increasing tuber size and yield of ware; Phosphorus increased tuber numbers and decreased ware percentage. Because of the heavy potassium content of the soils tested, responses to the potassium were slight. Cooking tests showed little effect of manurial treatment on the amount or degree of tuber blackening. The recommended fertilizer nutrient requirements for light and medium silt soils are N—200 kg/ha, $P_20_5$—130 ka/ha, and $K_20$—190 kg-ha. The same nutrient recommendations for the heavy silt soils were 200 kg-ha, 310 kg-ha, and 100 kg-ha respectively. (Frantz - East Central).

## 1070-B2, D3, E3, F5, F6

### PERIODICITY OF THE BLUE-GREEN ALGAE AND THEIR EFFECT ON THE EFFICIENCY OF MANURE-DISPOSAL LAGOONS,

Agricultural Engineering Research Division, Agricultural Research Service, U. S. Department of Agriculture; National Bontanic Gardens, Lucknow, India, respectively.
H. J. Eby, and V. P. Singh.
Government Printing Office No. 0100-1575, Washington, D. C., April, 1972, 8 p., 2 tab., 2 fig.

Descriptors: *Recycling, Nutrients, *Waste water, *Lagoons, *Algae, Bacteria, *Sewage, Oxidation, Climatic zones, Proteins, Farm wastes.

Identifiers: *India Waste disposal lagoons, Seasonal growth.

Research was done to provide a starting point for expanding feed production and aiding in the biological purification of waste water. Research in India reveals that blue-green algae has self-limiting tendencies and may be used advantageously. Since growth periods in the species vary, scientists might possibly anticipate each specie's population peaks thereby controlling algae growth. Harvesting of algae serves two purposes: (1) to remove organic matter from becoming a pollutant, and (2) to serve as potential livestock and poultry feed. (Frantz - East Central).

## 1071-A4, A6, A11, B2, C2, C3, D3

### A COMPARISON OF THREE SYSTEMS FOR TRANSPORT AND TREATMENT OF SWINE MANURE

Agricultural Engineering Department, Ames, Iowa; Agricultural Engineering Department, Corvallis, Oregon.
H. L. Person, J. R. Miner, T. E. Hazen, and A. R. Mann.
Presented at the 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-436, 30 p, 2 tab., 8 fig., 6 ref.

Descriptors: *Hogs, *Waste treatment, *Farm wastes, Feed lots, Iowa, *Aerated lagoons, *Oxidation lagoons, *Effluent, Nutrients, Bacteria, Fungi, Slime, Odor, Pumping, Maintenance, Water quality.
Identifiers: *Waste transport, *Waste management systems, Rotating biological contractor, Flushing gutter, Hydraulic cleaning.

Four engineers have demonstrated and evaluated three systems for hydraulic transportation and disposal of manure. The aeration basin, lagoon aeration basin, and rotating biological contractor systems all successfully used treated effluent as a cleaning medium in swine farrowing and finishing buildings. Aeration basins treated liquid manure. Pumping was done economically and excess water proved virtually odorless. The process didn't add significantly to either water pollution or animal health problems. Systems and equipment are described in detail. (Frantz - East Central).

## 1072-A4, A5, A6, A8, B3, C1, C2, C3, D3, E2

### HUMAN AND ANIMAL WASTES AS FERTILIZERS

The Metropolitan Sanitary District of Greater Chicago; University of Nebraska, Lincoln; University of Missouri Columbia, respectively.
J. R. Peterson, T. M. McCalla, and G. E. Smith.
Fertilizer Technology and Use, 2nd edition, Soil Science Society of America, p. 557-596, 1971, 27 tab., 8 fig., 42 ref.

Descriptors: *Farm wastes, *Sewage, *Waste disposal, Irrigation, Nitrates, Soil profiles, Lagoons, Pathogenic bacteria, *Fertilizers, *Water pollution, *Soil contamination, Odor, Leaching, Chemical properties, Physical properties, Microbial composition, Crops, Toxicity.
Identifiers: *Human wastes, Plant yields, Digested sludge.

Solid waste from municipal wastewater treatment plants in the United States is analyzed quantitatively and qualitatively. If properly digested, the sludge has little odor and is relatively free of pathogens. The use of digested sludge to ameliorate spoils has been proven. Three years' use of digested sludge on corn land has resulted in increased grain yields with no visual toxic symptoms to the plants. Qualitative and quantitative studies were also made on animal wastes. Although most pathogens are generally destroyed in the holding of wastes, weed infestations may be a problem with the application of animal waste to soil. Specific instances of waste utilization for soil improvement are cited for various states. (Wetherill - East Central).

## 1073-A8, B2, E2

### NITRATE CONTENT OF PERCOLATES FROM MANURED LYSIMETERS

University of Guelph, Guelph, Ontario, Department of Land Resource Science.
D. G. Bielby, M. H. Miller, and L. R. Webber.
Journal of Soil and Water Conservation, Vol. 28, No. 3, p. 124-126, May-June, 1973, 4 tab., 3 ref.

Descriptors: *Nitrates, *Farm wastes, *Lysimeters, *Corn, Slurries, *Waste disposal, Groundwater, Soils, *Poultry, Irrigation, Denitrification, Ontario.
Identifiers: *Percolates, Guelph sandy loam.

The quantity and concentration of nitrates in percolates from lysimeters receiving liquid poultry manure applications were determined over a 3-year period, Nitrogen removed by corn, plus that in percolates, accounted for less than 25 percent of the amount applied to the soil. Most nitrates in the percolates were discharged from the lysimeters after corn harvest. The average concentration of nitrates in percolates from all treatments and for all years exceeded 10 parts per million. (Bielby, Miller, & Webber—University of Guelph).

## 1074-A11, B1

### SHRINKING CATTLE FOR RELIEF FROM HEAT STRESS

U.S. Department of Agriculture, Davis, California; Imperial Valley Field Station, El Centro, California, Department of Animal Science.
S. R. Morrison, R. L. Givens, and G. P. Lofgreen.
Presented at the 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, 12 p., 5 tab., 1 fig.

Descriptors: *Cattle, *Sprinkling, Feed lots, Air conditioning, Temperature, Performance, California.
Identifiers: *Heat stress, Respiratory rate.

Sprinkling cattle under shades during the summer in the Imperial Valley of California for one minute every 30 minutes when the temperature was above 80°F resulted in significantly higher feed consumption and rate of gain, compared with cattle under shades and not sprinkled. Efficiency of feed conversion, although favoring the sprinkling operation, was not significantly improved over that of uncooled cattle. Sprinkling was as effective as a refrigerated air conditioned barn at 75°F in one trial and more effective during a second trial. Sprinkling and refrigeration promoted greater comfort as indicated by the prevention of increases in respiratory rate and body temperature observed in the afternoon with control cattle. Both noncooled and cooled cattle consumed more feed and gained more weight with 40 feet per head of space than with 20 feet. (Morrison, Givens, & Lofgreen—U.S. Department of Agriculture & Imperial Valley Field Station).

## 1075-B1, B5, C1, C2, F6

### THE EFFECT OF RATION ON ENGINEERING PROPERTIES OF BEEF CATTLE MANURE,

Agricultural Engineers, Chief Solid Waste Division, Lincoln, Nebraska Department of Environmental Control; Agricultural Research Service, University of Nebraska, Lincoln, U.S. Department of Agriculture.
G. A. Frecks, and C. B. Gilbertson.
Presented at the 66th Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-442, 34 p., 6 tab., 6 fig., 30 ref.

Descriptors: *Cattle, *Farm wastes, Kentucky, *Feeds, *Digestion, Volatility, Shrinkage, Porosity, Chemical properties, Physical properties, Volumetric analysis, Sieve analysis, Density, *Waste treatment, *Waste storage, Solids, Moisture content, Chemical oxygen demand, *Engineering.
Identifiers: *Ration, Drying rates.

Beef cattle were fed a high concentrate ration (HCR) and a high roughage ration (HRR) for five days. Samples of feces and urine were collected and analysed to assist in the engineering design of materials handling and processing equipment and storage facilities. The total, volatile, and fixed solids content was not affected by the ration. Of the HCR wastes, 20% was retained on a 2mm. sieve as compared to 3% for the HRR wastes. Volume change from original moisture contents to dry solids was 55% for the HCR and 7.4% for the HRR feces. Due to its more porous structure the HRR feces dried at twice the rate of the HCR. (Frantz - East Central).

## 1076-B1, C1, C2, C3, D1, D2, E3

### HIGH-TEMPERATURE, HIGH PRESSURE EXTRUSION OF CHICKEN EXCRETA,

University of Kentucky, Lexington, Department of Agricultural Engineering; Department of Animal Sciences, respectively.
F. A. Payne, I. J, Ross, H. E. Hamilton, and, J. D. Fox.
Presented at the Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-450, 23 p., 1 tab., 6 fig., 17 ref.

Descriptors: *Farm wastes, *Poultry, *Waste treatment, *Recycling, *Temperature, *Pressure, Moisture content.
Identifiers: *Extrusion, Thermal destruction, Uric acid, Chemical changes, Physical changes, Sterilization, Flash volitalization, Microbial organisms.

Chicken excreta and an excreta-feed mixture were extruded at a temperature range of 250° 300°F, for periods of 6.6 to 21.4 seconds. Pressures of 300 to 600 psi were utilized with the high temperatures to aid in microbial destruction. An analysis includes chemical and physical changes in the extruded material, Also given is an equation which can be used to predict microbial destruction. When extruded, chicken manure (which normally contains disease organisms) may become a versatile, low-cost, and highly productive food material. (Frantz - East Central).

## 1077-A5, A8, C2, E2

### SOIL CONDITIONS UNDER FEED LOTS AND ON LAND TREATED WITH LARGE AMOUNTS OF ANIMAL WASTES,

Southwestern Great Plains Research Center, Bushland, Texas, U. S. Department of Agriculture.
B. A. Stewart and, A. C. Mathers.
Contribution from Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture in cooperation with the Texas Agricultural Experiment Station, Texas A & M University, 3 p., 1 tab., 2 fig., 9 ref.

Descriptors: *Feed lots, *Farm wastes, *Water pollution, *Soil contamination, Cattle, *Nitrates, *Pollutants, Soil profiles, *Waste disposal, Water, Salt, Leaching.
Identifiers: *Soil conditions, Croplands,

Nitrate and other pollutants often accumulate in soil profiles under large feedlots. Water movement through these profiles, however, is usually very slow or does not occur, especially in the more arid areas. A greater pollution hazard results from spreading large amounts of animal wastes on cropland for the purpose of waste disposal rather than for improving soil conditions or crop growth and quality. A recent study showed that substantial quantities of nitrate accumulated when manure was applied to land at rates of 30 tons/acre or greater. Salt accumulation was also high enough to cause some injury to plant growth. Leaching can reduce the salt concentration, but may increase nitrate pollution of the drainage water. Indications are that pollution hazards are eliminated only when the growing crop utilizes most of the applied nitrogen. When the rate of manure application is too high, nitrate will accumulate in the soil and in some crops or will move through the soil with percolating water. (Stewart, Mathers—U. S. Department of Agriculture).

### 1078-A11, A12, C2, F6

### EXCRETION STUDIES IN SWINE FED ARSANILIC ACID,

Abbott Laboratories, North Chicago, Illinois, Nutrition Research Department.
L. R. Overby and, D. V. Frost.
Journal of Animal Science, Vol. 19, No. 1, p. 140-144, January, 1960, 2 tab., 9 ref.

Descriptors: *Arsenic, *Farm wastes, *Swine, *Diets, *Feeding, Poultry.
Identifiers: *Arsanilic acid.

The rates of arsenic excretion were determined in the feces and urine of swine receiving arsanilic acid at 30, 60 and 90 gm. per ton of feed. Much more arsenic was excreted in the feces than in the urine. After 10 days of arsanilic acid feeding, total excretion was in approximate balance with intake at the two lower levels of feeding. After the arsenical was withdrawn from the ration, the characteristic excretion level continued for two days, then decreased rapidly. This conforms with knowledge of the rate of disappearance of arsenic from tissues of animals fed arsanilic acid. The nature of the major part of the arsenical excreted was not determined. Unchanged arsanilic acid was not detected in the urine, but was present in the feces in an amount representing about 5% of the arsanilic acid consumed. (Overby & Frost—Abbott Laboratories).

### 1079-A11, B3, C2, E3

### UTILIZATION OF DIFFERENT LEVELS OF POULTRY LITTER NITROGEN BY SHEEP,

Virginia Polytechnic Institute, Blacksburg, Departments of Biochemistry and Nutrition and Animal Science.
A. N. Bhattacharya, and J. P. Fontenot.
Journal of Animal Science, Vol. 24, p. 1174-1178, 1965, 4 tab., 28 ref.

Descriptors: *Sheep, *Nitrogen, Fertilizers, *Protein, *Feeds, Farm wastes, Nutrition, *Chemical properties, Samples, *Metabolism, *Recycling.
Identifiers: *Digestibility, *Nitrogen retention, *Poultry litter, Peanut hulls, Crude protein, Soybean protein.

A series of three metabolism trials were conducted with eight yearling wethers to study the utilization of the nitrogen in auto-claved peanut-hull broiler litter, containing 22.6% crude protein (dry basis). Poultry litter nitrogen replaced approximately 25, 50 and 100% of the nitrogen of a purified ration containing isolated soybean protein as the nitrogen source. Apparent digestibility of crude protein in the rations decreased significantly with each increase in litter nitrogen level above 25%. However, the depression was small when litter supplied 50% of the nitrogen. When litter supplied 25 and 50% of the nitrogen, digestibility of litter crude protein calculated by difference was 67 and 65%, respectively, compared with 71% when only soybean protein was used. Nitrogen retention, expressed as grams per day, percent of nitrogen intake or percent of absorbed nitrogen, was significantly lower at the 100% litter nitrogen level than when no litter was used. There were no consistent differences in ammonia and non protein nitrogen content of rumen fluid and in concentration of various nitrogen fractions in the blood plasma of sheep fed the different rations. (Bhattacharya and Fontenot — Virginia Polytechnic Institute)

### 1080-A4, A5, A7, A8, A12, C2, F4

### NITROGEN COMPOUNDS IN NATURAL WATER—A REVIEW,

U. S. Geogogical Survey, Menlo Park, California.
J. H. Feth.
Water Resources Research, Vol. 2, No. 1, p. 41-58, 1st Quarter, 1966, 9 tab., 1 fig., 87 ref.

Descriptors: *Nitrogen, Water, *Farm wastes, Groundwater. Public health, Fixation, *Nitrogen cycle, *Water pollution, Air pollution, Soil Contamination, Fertilizers, Proteins, Rocks, Leaching, Precipitation, Atmosphere, Ammonia, Aerosols, Water quality, Geochemistry.

Nitrogen compounds in natural water are significant in public health, agriculture, industry and geochemistry. The many sources of nitrogen compounds and the deep involvement of nitrogen in the life processes of organisms makes the study of such compounds difficult. The sources include natural aerosols, precipitation, fixation by micro-organisms in soil and water, decaying organic matter, and animal and industrial wastes, as well as probably undiscovered sources in consolidated and unconsolidated rocks. Nitrogen compounds are both oxidized and reduced by organisms. Some nitrogen compounds are absorbed on clay. The theoretical end product in water and the compound probably most often determined is $NO_3$-1. The concentration of nitrogen compounds ranges from 0.0 to > 100 ppm. (parts per million) in surface water and from 0.0 to > 1000 ppm. in groundwater. Seasonal fluctuations occur. Much further research is needed, including improvements in methods of analysis, further investigation of sources, and detailed study of the nitrogen cycle in small drainage basins. (Feth—U. S. Geological Survey).

### 1081-D2, E3

### CONVERTING ORGANIC WASTES TO OIL,

Pittsburgh Energy Research Center, Pittsburgh, Pennsylvania.
H. R. Appell, Y. C. Fu, S. Friedman, P. M. Yavorsky, and I. Wender.
Bureau of Mines Report of Investigation/1971, RI 7560, U. S. Department of Interior, 1971, 20 p., 10 tab., 3 fig.

Descriptors: *Recycling, *Sewage sludge, *Farm wastes, Agricultural wastes, Wood, Lignins, Water, Temperature, Catalysts, Solvents, *Conversion, *Oil, *Solid wastes.
Identifiers: *Low-sulfur oil, refuse, Carbon monoxide, *Liquid fuels, "Waste products, "Continuous reactor, Sucrose.

The Bureau of Mines is experimentally converting cellulose, the chief constituent of solid waste, to a low-sulfur oil. All types of cellulosic wastes, including urban refuse, agricultural wastes, sewage, sludge, wood, lignin, and bovine manure, have been converted to oil by reaction with carbon monoxide and water at temperatures of 350° to 400° C and pressures near 4,000 psig, and in the presence of various catalysts and solvents. Cellulose conversions of 90 percent and better (corresponding to oil yields of 40 to 50 percent) have been obtained. A continuous reactor for use at maximum conditions up to 800° C and 5,000 psig has been operated successfully. Using sucrose as a feedstock, operation in this system has permitted a simplified and preliminary chemical study of the conversion process. Oil yields of over 30 percent have been obtained with this unit. (Appell, Fu, Friedman, Yavorsky, & Wender - Pittsburgh Energy Research Center).

### 1082-B3, D2, E3, E4, F1

### COSTS FOR LARGE SCALE CONTINUOUS PYROLYSIS OF SOLID WASTES,

Texas Tech University, Lubbock, Department of Chemical Engineering.
H. W. Parker, C. J. Albus, Jr., and G. L. Smith.
Presented at the 74th National Meeting, American Institute of Chemical Engineers, New Orleans, March 12, 1973, Paper 43 b-rv, 4 tab., 5 fig., 17 ref.

Descriptors: *Solid wastes, *Costs, Cattle, Feedlots, *Waste disposal, *Recycling, *Electricity, *Farm wastes, Gases, Fuels, Fertilizers, *By-products, *Sodium chloride.
Identifiers: *Pyrolysis, Municipal wastes, *Retort, Char, *Pollution abatement.

Conceptual process designs which utilize the recently developed TTU retort to pyrolyze 2,000 tons per day of either municipal solid waste or cattle feedlot waste are reported. The major product of these processes is the production of 30 megawatts of electricity. A governmental entity which could finance the required 15 million dollar investment with 6 per cent bonds over a 20 year period would have to charge users $1.70 per ton of municipal refuse processed or $0.70 per ton of feedlot waste pyrolyzed. (Parker, Albus, Smith - Texas Tech University).

### 1083-A4, A7, B2, D2, E3, E4

### CONTINUOUS SOLID WASTE—FEASIBILITY STUDY,

Dow Chemical Company, Freeport, Texas, Contract Research Department and Texas Tech University, Lubbock, Department of Chemical Engineering.
J. R. Massie, Jr., and H. W. Parker.
Paper presented to the 74th National Meeting of the American Institute of Chemical Engineers, New Orleans, March 12-15, 1973; Paper No. 43a, 31 p., 12 fig., 6 ref.

Descriptors: *Cattle, *Farm wastes, *Waste disposal, Recycling, *Solid wastes, Oxidation, Temperature, Energy, By-products, Economics, Texas, Air pollution, Water pollution, Drying.
Identifiers: Pyrolysis, *Continuous retort, Municipal refuse, Agricultural crop wastes, Char products, Fuel.

Continuous pyrolysis of a solid waste, cattle manure containing 30% moisture, was demonstrated in a six inch diameter retort at a mass flow rate of 136 lb/hr ft$_2$. The retort was an open cylinder with a grate at the bottom. Cyclic injection of oxygen containing and oxygen free gas served to limit the heated zone of the retort to its midsection, which contained no mechanical parts. Maximum temperatures in the hot zone were controlled by mixing oxygen free gas with the injected air. This retort may also be used for municipal refuse, agricultural crop waste, or natural resources such as oil shale and coal. When integrated into a process energy and by-products can be recovered from the retort as justified by economics, also air and water pollution problems can be easily controlled. (Massie, Parker - Dow Chemical Company).

### 1084-B3, D2, E3, E4

### CONVERSION OF URBAN REFUSE TO OIL,

Pittsburgh Energy Research Center, Bureau of Mines, Pittsburgh, Pennsylvania.
H. R. Appell, I. Wender, and R. D. Miller.
Conversion of Urban Refuse to Oil, Bureau of Mines Solid Waste Program, Technical Progress Report-25, U.S. Department of Interior, May, 1970, 5 p., 3 tab.

Descriptors: *Recycling, Temperature, *Sewage sludge, *Oil, Water, Gas, Steam, Sulfur, Organic matter.
Identifiers: *Processing, Furnace, *Fuels, *Urban refuse, *Cellulosic wastes, Carbon Monoxide.

Urban refuse, cellulosic wastes, and sewage sludge have been converted to heavy oil by heating under pressure with carbon monoxide and steam. Conversion of the organic matter to oil, water, and gas have averaged near 90 percent at temperatures of 250° to 400° C and pressures of 1,500 to 5,000 psi. The yield of oil, based on the dry organic matter of the waste materials, is usually near 40 percent. This is the equivalent of more than 2 barrels of oil per ton of dry, ash-free waste material. The oil from urban refuse and cellulosic wastes has a sulfur content near 0.1 percent. This low sulfur content makes the oil from refuse a desirable source of fuel oil. (Appell, Wender, Miller - Pittsburgh Energy Research Center).

### 1085-B2, C1, C2, C3, D1, E1

### CHARACTERISTICS OF RAINFALL

## RUNOFF FROM A BEEF CATTLE FEEDLOT,

Environmental Protection Agency
Robert S. Kerr Water Research Center,
Ada, Oklahoma.
R. D. Kreis, M. R. Scalf, and J. McNabb.
Environmental Protection Agency report number EPA-R2-72-061, September, 1972, 43 p., 10 tab., 2 fig., 26 ref.

Descriptors: *Cattle, *Confinement pens, *Rainfall-Runoff relationships, *Pollutants, Farm wastes, Nutrients, Bio-chemical oxygen demand, Chemical oxygen demand, Coliforms, Streptococcus,
Identifiers: *Feedlot, *Manure wastes, *Wastes characteristics, Solids, Total organic carbon.

Rainfall runoff from a 12,000-head capacity commercial beef cattle feedlot was characterized and a treatment-disposal system used by the feedlot was evaluated. Fifty percent of the rainfall events produced measurable runoff from the feedpens. A four-to ten-inch manure mantle of the feedpen surface was found to prevent runoff from 0.2— to 0.3-inch rainfalls depending on intensity and antecedent moisture conditions. The total runoff from the feedpens was equivalent to 39 percent of the total rainfall during the study period. Direct runoff from the feedpens contained pollutant concentrations in the form of oxygen demand, solids, and nutrients that were generally an order of magnitude greater than concentrations typical of untreated municipal sewage. Dilution from direct rainfall and a few days of sedimentation in the runoff collection ponds reduced the concentrations of the pollutants up to 90 percent. The total weight of solids and oxygen demanding materials was reduced by about one-half, but the total weight of nutrients was not significantly reduced. The remainder of the treatment disposal system produced no appreciable improvement in the quality of the waste water. Final discharges still contained pollutant concentrations two to three times those of untreated municipal sewage. (Kreis, Scalf, McNabb - Environmental Protection Agency).

## 1086-A11, E3, F6

## THE EFFECT OF FEEDING LAYING HENS VARIOUS LEVELS OF COW MANURE ON THE PIGMENTATION OF EGG YOLKS,

A.R.S. Animal Science Research Division, Poultry Research Laboratory, Georgetown, Delaware, U. S. Department of Agriculture.
L. H. Littlefield, J. K. Bletner, and O. E. Goff.
Poultry Science, Vol. 52, No. 1, p. 179-181, January, 1973, 3 tab., 10 ref.

Descriptors: *Recycling, Cattle, *Farm wastes, Poultry, *Diets.
Identifiers: *Blood xanthophyll levels, *Yolk pigmentations, Blood.

Dried cow manure was added at the rate of 0, 2.5, 5, or 10 kilograms per 100 kilograms of diets containing 0 and 23 milligrams of xanthophylls per kilogram of diet to determine the effect on blood xanthophyll levels and the pigmentation of yolks produced by hens on these diets. There was a high positive linear correlation between the amount of cow manure added and the amount of xanthophyll in the blood, the amount of xanthopyhll in the egg yolk and the yolk visual score. There was a high negative linear correlation between pigmenting efficiency and the amount of cow manure added to the diet. Although cow manure was a good source of xanthophylls, it was not efficiently utilized by the hen as a source of xanthophylls. (Littlefield, Bletner, Goff - U.S. Department of Agriculture).

## 1087-A4, A5, A7, A11, A12

## ENRICHMENT OF THE ATMOSPHERE WITH NITROGEN COMPOUND VOLATILIZED FROM A LARGE DAIRY AREA,

Soil scientists, U. S. Department of Agriculture, and Staff Research Associate, University of California, Riverside.
R. E. Leubs, K. R. Davis, and A. E. Laag.
Journal of Environmental Quality, Vol. 2, No. 1, p. 137-141, January-March, 1973, 3 tab., 3 fig., 18 ref.

Descriptors: *Dairy industry, *Cattle, *Nitrogen, Ammonia, *Air pollution, Feed lots, *Water pollution, Toxicity, *Farm wastes, Sampling, Temperature, Humidity, Winds, Rainfall.
Identifiers: *Distilled nitrogen, Nondistillable nitrogen, Atmospheric $NH_3$, Enrichment.

A dairy cow population of 143,000 in an area of 150 $KM_2$ enriched the atmosphere with distillable N (mostly $NH_3$) over an area in excess of 560 $KM_2$, over an area of 35 $KM_2$, where cow population density was approximately 1,600 cows $KM_2$, the concentration of distillable N in the atmosphere was between 20 and 30 times greater than at a control site outside the dairy area. Highest concentrations of N were associated with wet corral surfaces and favorable evaporative conditions. Approximately 20% of the total N absorbed by acid-surface traps in the dairy area was nondistillable N while filtered air samples contained 3% or less. Rainfall delivered three times as much N to the land surface inside than outside the dairy area.. (Luebs, Davis, Laag-U.S. Department of Agriculture and University of California).

## 1088-A11, B5, C2

## OBSERVATIONS ON THE EFFECT OF PROTEIN INTAKE AND STAGE OF GESTATION ON THE PROPORTION OF URINARY NITROGEN EXCRETED AS UREA IN SHEEP,

Rowett Research Institute, Bucksburn, Aberdeen, AB2 9SB.
J. J. Robinson, D. Scott, and C. Fraser.
The Journal of Agricultural Science, Vol. 80, No. 2, p. 363-368, June, 1973, 3 tab., 4 fig., 14 ref.

Descriptors: *Sheep, Diets, Energy.
Identifiers: *Protein intake, *Gestation, *Urinary nitrogen, Nitrogen retention.

The effect of altering the level of protein intake on urea excretion in ewes was assessed in two separate experiments. In Experiment 1, 14 pregnant (during the last 30 days of gestation) and 10 non-pregnant ewes were each offered a different level of digested N intake in the range 5-25 g/day. At all levels of protein intake urea N excretion was lower in pregnant than in non-pregnant ewes. In Experiment 2, 21 pregnant ewe lambs were each offered one of three diets supplying mean intakes of 83 (T, 1), 113 (T 2) or 147 (T 3) g crude protein/day. During the last 100 days of gestation the mean levels of urea N excretion were 6.9, 11.0 and 15.2 g/:day for T 1, T 2 and T 3, respectively. The corresponding values for urinary N excretion were 9.3, 13.8 and 18.2 g/day. At all levels of protein intake urea N excretion was lower just prior to parturition than 95 days prepartum; the difference was correlated with lamb birth weight and maternal body-weight change. A notable feature of both experiments was the low level of urea N excretion by the pregnant ewes in late gestation, at low protein intakes. It would appear that when energy intake is adequate the decrease in urea N excretion associated with pregnancy is a direct result of an increased N requirement for maternal and/or foetal growth, (Robinson, Scott, and Fraser - Rowett Research Institute).

## 1089-B2, C2, D3, E3, F1

## A RECYCLED FEED SOURCE FROM AEROBICALLY PROCESSED SWINE WASTES,

University of Illinos, Urbana, Agricultural Engineering Department and Animal Science Department, respectively.
D. L. Day, B. G. Harmon.
Presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-954, 10 p., 7 tab., 5 fig., 21 ref.

Descriptors: *Recycling, *Feeds, *Swine, *Farm wastes, Aerobic conditions, Water, Nutrients, *Oxidation lagoons, Proteins.
Identifiers: Odor control, Rats, *Waste management.

An intriguing amount of protein was noticed in swine oxidation ditch mixed liquor at the University of Illinois in 1967. Studies have been in progress since then to measure the nutritive value of the aerobically processed product and use it as a feed supplement in feeding trials to rats and hogs. Several methods of concentrating and feeding the product have been tried. Utilizing this product provides a source of water and nutrients for swine while minimizing environmental pollutants (air, water, soil). There is odor control and little if any effluent from the building. The results have been very favorable and economics appear competitive with other methods of waste management with a high degree of pollution control. (Day, Harmon - University of Illinois).

## 1090-A9, A10, A11, A12, B1

## COUMAPHOS AS A FEED ADDITIVE FOR THE CONTROL OF HOUSE FLY LARVAE IN COW MANURE,

Agricultural Research Service, Beltsville, Maryland and Tifton, Georgia, U. S. Department of Agriculture.
R. W. Miller, C. H. Gordon, N. O. Morgan, M. C. Bowman, and M. Beroza.
Journal of Economic Entomology, Vol. 63, No. 3, p. 853-855, June, 1970, 3 tab., 14 ref.

Descriptors: *Feeds, *Additives, *Cattle, *Farm wastes, Dairy industry, *Mortality, Milk, *Insecticides, Larvae.
Identifiers: *Coumaphos, *House flies, Musca domestic L.

The mortality of first-stage larvae of the house fly, *Musca domestica* L., seeded into the manure of dairy cows consuming 0-144 ppm coumaphos in their ration increased as the concentration of coumaphos in the ration was increased. At the 144 ppm level, larval mortality approached 100%. Although coumaphos residues were found in the feces no residues L 0,002 ppm) appeared in the milk of cows at any level of coumaphos fed. Neither feed intake nor milk production was affected by the feeding of coumaphos. The blood cholinesterase of 1 cow fed 150 ppm coumaphos over a 6-week period dropped to 20% of pre-experimental levels.' (Miller, Gordon, Morgan, Bowman, Beroza - U. S. Department of Agriculture).

## 1091-A9, A10, B1

## TOXICITY OF DROPPINGS FROM COUMAPHOS-FED HENS TO LITTLE HOUSE FLY LARVAE,

University of Massachusetts, Amherst, College of Agriculture, Department of Entomology and Plant Pathology.
J. S. Eversole, J. H. Lilly, and F. R. Shaw.
Journal of Economic Entomology, Vol. 58, No. 4, p. 709-710, August, 1965, 1 tab., 4 ref.

Descriptors: *Poultry, *Farm wastes, *Toxicity, *Insecticides, Massachusetts.
Identifiers: Flies, Larval: mortality, Coumaphos oral drench powder, Fannia canicularis, white leghorn hens.

White leghorn hens were fed mixtures of 50% coumaphos oral drench powder, and pelleted poultry feed. The insecticide levels were 0, 25, 75, and 125 mg of active ingredient per kg of feed. The mean mortalities of larvae of Fannia canicularis (L.) exposed to the droppings from these birds were 7.3, 18.O, 42.5, and 91.0%, respectively. Therefore coumaphos provided an effective degree of control when fed at the 125 mg/kg level. By a comparison of the concentrations of coumaphos required to produce approximately 90% mortality of the fly larvae in this field test with the results of our laboratory tests, it was estimated that approximately a 70-fold decrease in effectiveness occurred during passage of the insecticide through the birds. (Eversole, Lilly, & Shaw - University of Massachusetts).

### 1092-A9, A10, B1

**EFFECT OF BACILLUS THURIENGSIS IN CATTLE MANURE ON HOUSE FLY LARVAE,**

Animal Science Research Division, Agricultural Research Service, Beltsville, Maryland; Entomology Research Division, Agricultural Research Service, Beltsville, Maryland.
R. W. Miller, L. G. Pickens, and C. H. Gordon.
Journal of Economic Entomology, Vol. 24, No. 4, p. 902-903, August, 1971, 2 tab., 11 ref.

Descriptors; *Cattle, *Farm wastes, Larvae, *Mortality, Additives, Feeds, Poultry.
Identifiers: *Fly control, Bacillus thuringiensis Berliner, *Musca domestica L., Biotrol BTB-183.

A commercial formulation of Bacillus thuringiensis Berliner, Biotrol BTB 183-25 W, was fed to dairy cattle in an attempt to control house fly, Musca domestica L., larvae in the feces. A maximum larval mortality of 32% was obtained when cows were fed 3200 ppm of this formulation. In an in vitro experiment, complete control of house fly larvae was obtained to a level of 12,800 ppm of feces. (Miller, Pickens, Gordon - Agricultural Research Service).

### 1093-A11, A12, B3, E3

**DEHYDRATED POULTRY MANURE AS A CRUDE PROTEIN SUPPLEMENT FOR SHEEP**

Biological Waste Management Laboratory, Beltsville, Maryland, U. S. Department of Agriculture.
L. W. Smith, C. C. Calvert, and J. R. Menear.
Proceedings 1973 Maryland Nutrition Conference for Feed Manufacturers, The University of Maryland. The American Feed Manufacturers Association cooperating, March 15-16, 1973, p. 35-44, 15 tab., 1 fig., 14 ref.

Descriptors: *Farm wastes, *Arsenic, *Sheep, *Nitrogen, *Feeds, Growth, Nutrition, Chemical properties, *Recycling.
Identifiers: *Poultry manure supplemented diets, Feed additives, Digestibility, Soybean oil meal.

Despite possible arsenical residues, dehydrated poultry-manure supplemented diets were consumed by sheep as readily as diets supplemented with soybean oil meal. Nitrogen from broiler manure supplemented diets was not significantly less digestible than SBOM nitrogen and was retained in the sheep equally well. The true digestibility of DPM-N was determined to be 81%, a value of similar magnitude determined by others for dry-mixed conventional feeds. Arsenic from different sources ingested by sheep was detected in all tissues assayed. Withdrawal of arsenic from feed results in a rapid decrease in tissue arsenic concentration. Significance of arsenic in poultry manure processed for ruminant CP supplements will depend on individual feeding regimes, arsenic concentration in manure and permissible levels established for lamb and mutton. (Smith, Calvert, and Menear - U.S. Department of Agriculture).

### 1094-A4, A7, A9, B1, F1, F2

**AGRICULTURE AND POLLUTION SOCIO - ECONOMIC ASPECTS,**

University of Kentucky, Lexington, College of Agriculture.
A. F. Bordeaux, Jr.
Presented at the College of Agriculture Annual Conference, University of Kentucky, January 5-7, 1971, p. 1-7, 6 ref.

Descriptors: *Water pollution, *Economics, Surface waters, Technology, *Fertilizers, Conservation, Insecticides, *Farm wastes, Nitrates, Farm prices, Costs, *Waste disposal, Water treatment, DDT, Regulation, Kentucky, Agriculture.

As the interest in environmental protection heightens in the United States, farmers are increasingly criticized as pollutors of air and water. Costs of pollution must be met and farmers, declining in political power, feel the most pressure. Alternative chemicals are available to replace the DDT family, but they are less effective and more expensive, Providing for economical environment protection requires the cooperative efforts of economists, engineers and scientists. (Frantz - East Central).

### 1095-A3, A4, A7, A8, A9, A12

**BIOLOGICAL ASPECTS OF AGRICULTURE'S EFFECTS ON ENVIRONMENTAL QUALITY,**

University of Kentucky, Department of Entomology.
H. W. Dorough.
Presented at the College of Agriculture Annual Conference, University of Kentucky, January 5-7, 1971, p. 8-13.

Descriptors: *Agriculture, Kentucky, Runoff, Farm wastes, Surface waters, *Insecticides, Toxicity, Soils, Dairy industry, Erosion, Fertilizers, Livestock, *Air pollution, *Water pollution, *Soil contamination, Sedimentation.
Identifiers: *Tobacco Industry, *Environmental quality.

Agriculture depends upon maintaining a quality environment. But, it may have various detrimental effects on that environment. The Environmental Quality Task Force in the University of Kentucky College of Agriculture was established to evaluate the following problems: pesticides, sediment, farm wastes and fertilizers. Concentrated pesticide use contaminates surface water, air and especially soil, Erosion and sedimentation aid in the transportation of pollution in streams. The phosphorus and nitrogen from farm wastes and certain nutrients from fertilizers are major sources of water pollution. Evaluation of the general use of pesticide contamination problem in Kentucky indicates cause for concern, but the situation is not yet critical. (Frantz - East Central).

### 1096-A4, A5, A6, A8, B2, B3, D1, D2, D3, E1, E2

**ENGINEERING AGRICULTURAL WASTES,**

University of Kentucky, Lexington, Agricultural Engineering Department.
B. J. Barfield, H. E. Hamilton, and I. J. Ross.
Presented at the College of Agriculture Annual Conference, University of Kentucky, January 5-7, 1971, [illegible]

Descriptors: *Dehydration, Land use, Proteins, Erosion, Technology, *Waste disposal, Lagoons, Kentucky, Insecticides, Odor, Livestock, Oxidation lagoons, *Farm wastes, *Air pollution, *Water pollution, *Soil contamination.
Identifiers: Composting, Microbial disposal.

The extension of cities into farming areas, demands for more uniform quality products, increased farm production and increasing demands for processed foods are among recent trends causing problems for agricultural waste management. Soil erosion accounts for approximately 88% and livestock wastes for 11% of all agricultural pollution. But the amount of livestock waste that must be handled by mass management methods is expected to double by 1980. Soil disposal and microbial disposal media are the most common while composting and dehydration are also used, All agriculture waste problems must be met with technological, social economical acceptability. (Frantz - East Central).

### 1097-A5, C2

**NITRATE CONCENTRATIONS IN GROUNDWATER BENEATH A BEEF CATTLE FEEDLOT,**

U. S. Department of Agriculture, Gunnison, Colorado and U. S. Department of Agriculture, Lincoln, Nebraska.
J. C. Lorimor, L. N. Mielke, L. F. Elliott, and J. R. Ellis.
Water Resources Bulletin, Vol. 8, No. 5, p. 999-1005, October, 1972, 3 tab., 4 fig., 6 ref.

Descriptors: *Nitrates, *Cattle, *Feed lots, *Water pollution, Irrigation, *Farm wastes, *Groundwater, *Water quality, Aquifer, *Samples, Nebraska, Wells.
Identifiers: 3-day study, transmissvity.

A study of nitrate concentration in the groundwater beneath a beef cattle feedlot near Central City, Nebraska was started in 1968. An intensive 3-day pumping study was conducted at the feedlot at the start of 1970 irrigation system. Little nitrate concentration was found in the groundwater coming from beneath the feedlot. Pumping caused a slight increase in nitrate concentration over the average concentration for the previous 2 years. (Lorimor, Mielke, Elliott, Ellis - U. S. Department of Agriculture).

### 1098-A4, E3

**BIBLIOGRAPHY OF PRODUCTS DERIVED FROM AQUATIC ORGANISMS.**

Coastal Plains Center for Marine Development Services, Wilmington, N.C.

Center Publication No 71-3, August 1971. 113 p.

Descriptors: *Aquatic plants, *Fish, Poultry, Mink, Swine, Ruminants, Foods, *Water pollution control, Sewage treatment.
Identifiers: *Animal husbandry, *Fish protein.

367 REFERENCES INCLUDE INFORMATION ABOUT BOTH FOOD AND MEDICAL PRODUCTS WHICH CAN BE OBTAINED FROM AQUATIC ORGANISMS. References on direct consumption of sea products, such as fishing methods and the use of fresh fish or shellfish, are excluded. Main emphasis is on conversion of aquatic plants and animals to products such as fertilizers, food supplements for domestic animals and man, drugs, other pharmaceuticals, and aquatic organisms for water pollution control. There is a permuted title index and an author index.

### 1099-A4, A9, A12, B2, B3, C3, D3

**SUMMER CONFERENCE OF SOCIETY FOR APPLIED BACTERIOLOGY, LIVERPOOL, 13-15 JULY 1971,**

Office of Naval Research, London (England).
G. A. Hottle. Report No. ONRL-C-19-71, 31 August 1971. 12 p, 11 ref.

Descriptors: *Microorganisms, *Water pollution control, *Wastes, *Pathogenic bacteria, Conferences, *Public health, Rivers, *Sewage, Biochemical oxygen demand, Solid wastes, Ammonia, Nitrogen compounds, Nitrates, Phosphates, Sludge treatment, Dissolved oxygen, Bacteria, Fungi, Protozoa, Fermentation, Bacteriophage, Nutrients, Filters Equipment, Oxidation, Lakes, Wisconsin, Anaerobic digestiion, Algae, Eutrophication, Biodegradation, Plastics, Phosphorus compounds, Soil fungi, Pseudomonas, Dairy industry, Municipal wastes, Herbicides, Soil bacteria, Pesticides, Industrial wastes, DDT, Trace elements, Water quality, Detergents, Farm wastes, Urine, Aerobic bacteria, Carbohydrates, Bactericides, Clostridium, Streptococcus, Salmonella, Water purification, Sheep, Yeasts, Foods, Anaerobic bacteria, Soil contamination, Waste treatment, Organic matter, Digestion, Activated sludge, Actinonycetes, Hydrocarbon pesticides, Viruses, Water pollution sources, Water pollution effects, Path of pollutants.
Identifiers: Bdellovibrid, Pelodictyon, Polioviruses, Plasticizers, Phthalate, Thermophilic fungi, Polyethylene, Polypropylene, Bacillus, Corynebacteria, Streptothrix hyorhina, Cadmium, Dimethylnitrosamine, Amines, Carcinogens, Torulopsis spp., Aspergillus, Penicillium, Fusaria, Vibria.

The annual conference of the Society for Applied Bacteriology, held at the University of Liverpool, 13-15 July 1971, included a two-day symposium on 'Microbiol Aspects of Pollution' and a one-day session devoted to papers on individual research.

The following topics were discussed: (1) water pollution by domestic, agricultural and industrial wastes, (2) sewage treatment using combined aerobic-anaerobic systems, (3) microbial ecology of the activated sludge process, (4) microbial aspects of pollution in the food and dairy industry, (5) pollution of freshwaters with inorganic nutrients, (6) microbial degradation of plastics, herbicides, and pesticides, (7) aerobic methods for the treatment of farm wastes, (8) factors affecting algal blooms, (9) the role of obligate anaerols in the digestion of organic material, (10) health hazard of pollution, and (11) sewage pollution of natural waters. Individual research topics included (1) 'An Evaluation of Procedures for Enumerating Bacteria in Activated Sludge', (2) 'The Microbial Pollution of Water Courses as a result of the Sewage and Animal Wastes and the Application of Animal Slurry to Land', and (3) 'Methods for Analyzing the Microbial Decay of Solid Wastes'. (Jefferis-Battelle)

### 1100-A4, A11, C2

### DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT,

Interuniversitair Reactor Instituut, Delft (Netherlands).
J. J. M. De Goeij. Report No IRI-133-71-17,
1971. 21 p, 12 fig, 1 tab, 10 ref.

Descriptors: *Mercury, *Neutron activation analyzis, Chemical analysis, *Industrial wastes, *Pollutant identification, Water pollution sources, Heavy metals, Separation techniques, Irradiation, Sediments, Cattle, Birds, Foods, Plants, Marine fish, Toxicity, Milk, Water analysis, Marine animals, Salmon, Herrings, Commercial fish, Automation.
Identifiers: *Biological samples, *Methyl mercury, *Rhine River, Seals (Animals), Tuna, Mackerel, Pilchard, Cod, Haddock, Liver, Brain, *Netherlands, Body fluids, Environmental samples.

Samples of sediments; biological tissues and fluids (birds, fishes, and man); human hair; foodstuffs; industrial products and pharmaceuticals; and plants and water were analyzed for mercury by neutron activation analysis. These samples, ringing from 100 mg-l/g, were irradiated in quartz vials, automatically decomposed and oxidized by sulfuric acid and hydrogen peroxide, and volatilized at 200C with HBr into a sodium acetate solution. Inactive mercury was added to the solution and stirred for 1 hr to break the mercury into small droplets to ensure isotopic exchange. The Hg was then collected on a sintered glass filter, washed with water then acetone, and finally dissolved in nitric acid and counted in a well type sodium iodide crystal. A sensitivity and an accuracy of 1.0-0.1 ppb/gram sample and 97-98 percent yield were achieved, respectively. Results showed that (1) one quarter of the birds tested had been killed by methylmercury; (2) in the food chain: sediments - grass - cow - milk, cumulative effects were absent; (3) Rhine River sediments showed increases of 18-23 ppm compared to previous tests; and (4) while Dutch fish, seals and coastal marine organisms were generally contaminated, imported canned fish and cod liver oil were in low ranges. Separate measurements showed not only that tuna had higher concentrations but that about 80 percent of the mercury in all fish was present as lipophilic methylmercury. (Mackan-Battelle)

### 1101-C3, F6

### BACTERICIDAL EFFECTS OF ALGAE ON ENTERIC ORGANISMS,

Texas University, Austin, Center for Research in water resources.
Ernest Davis, and Earnest Gloyna.
FWPCA grant 18050 DCL, Technical Report EHE-70-06, CRWR-55, 132 p. March 1970, 9 fig., 144 tab., 60 ref.

Descriptors: *Algae, *Cultures, *Enteric Bacteria, *Oxidation lagoons, *Pathogenic bacteria.
Identifiers: Autogomistic effects, *Axenic cultures, *Dieoff fates, Aftergrowth, Blue-green algae, Field studies, Green algae, Laboratory studies.

A series of experiments involving the effects of blue-green and green algae on the dieoff rates of selected bacteria were conducted. Aexmic cultures of anabaena cyclindrica, A. niculans, oscillatoria chalybia, chiorella pyrenoidoso and scendedesm obluguus among others. Cultures of enteric bacteria species (adcaligeues, faecalis, enterobactec aerogenes, E. coli proteus vulgaris, psudomonas aerorginosa, and serratio marcercens) were added to the oxenic algal cultures during different periods of the algal life cycles. Filtrate from actively growing algae was exposed to cultures of enterics to determine whether any antibiotic compounds were imparted to the medium during lag phase growth of algae. To determine aftergrowth of the enteric species, the duration of the tests was extended to about 90 days. Mixed cultures of green and blue-green algae were exposed to both single species of enteric bacteria and mixed cultures. Mixed algal cultures cause a greater dieoff among the enteric bacteria than do individual species of algae. The dieoff characteristics of pathogenic species, namely Salmonella Typhosa, S. Paratyplin, Shigella Cysentiriae, S. Paracysentesiae, and Vibrac Comma were also determined. The pathogenic species did not survive as long as the enteric test species under similar test conditions. Virtually no aftergrowth was detected on the part of Pathogenes. (Aguirre - Texas).

### 1102-B2, C3, D3, F1

### MICROBIOLOGY OF A WASTE STABILIZATION POND,

Central Public Health Engineering Research Inst., Nagpur (India).
M. V. Bopandikar.
In: Advances in Water Pollution Research, Proceedings Fourth International Conference on Water Pollution Research, held in Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, Sec II, Paper 16, September 1968. 7 p, 32 ref.

Descriptors: *Biological treatment, *Microbiology, *Oxidation lagoons, Bacteria, Efficiencies, Lagoons, Microorganiams, Organic Loading, Pathogenic bacteria, Ponds, Viruses.
Identifiers: *Bacterial removal, Viral removal.

Stabilization ponds developed by the author in India successfully treat sewage with an average BOD of 300 mg/l to 10 mg/l at a cost of only Rs. 40,000/MGD as against Rs. 1,000,000/MGD with conventional treatment. No work, however, has been done in India on the reduction of pathogens by pond stabilization treatment. Many variables affect the types and quantities of enteric viruses that occur in sewage and the limitations of available techniques for their detection further complicate attempts to judge their significance. A review of the techniques developed for sampling and concentration of viruses from large volumes of water is presented. Methods employed for collecting sewage samples for quantitative determination of viruses include: (1) the gauge pad or swab method, (2) resin adsorption method, and (3) ultra-centrifugation. It is shown that conventional secondary treatment (including chlorination) is not effective in removing virus contamination. However, marked reduction in the yield of viruses occurred during passages through oxidation ponds. Reduction in coliforms of fecal E. coli and fecal streptococci during 30 days passage through oxidation ponds ranged between 96.0 and 99.9%.
(Aguirre-Texas)

### 1103-A4, A5, A12, F2

### ENFORCEMENT OF WATER POLLUTION LAWS IN OKLAHOMA.

Oklahoma Law Review, Vol 22, No 3, p 317-345 (1969). 29 p, 180 ref.

Descriptors: *Oklahoma, *Water pollution sources, *Administrative agencies, *Pollution abatement, Watercourses (Legal), Surface waters, Groundwater, Water supply, Water reuse, Water sources, Industrial wastes, Farm wastes, Sewage, Waste disposal, Waste treatment, Water users, Water quality, Standards, Wildlife conservation, Oil industry, Saline water intrusion, Toxins, Sediments, On-site investigations, Hydrologic cycle.

The article examines first the factors determining the nature and extent of water pollution: (1) the character of the state's water resources, their quality, quantity, and availability; and (2) the causes of water pollution categorized into the petroleum and other industries, agriculture, and municipal wastes. The second section of the article examines water pollution law as implemented by case law, legislation, or regulatory agencies' rules. Private remedies are discussed in regard to: (1) injuries to land and chattels; (2) nature of defendant's act; (3) nature of recovery; (4) plaintiff's standing; (5) defenses; (6) injury to water use rights; and (7) statute of limitations. The growth of a comprehensive state administrative program is explained. There are six agencies which administer this program: (1) the Pollution Control Coordinating Board has various coordinating functions; (2) the Water Resources Board performs industry plant inspections; (3) the Corporation Commission regulates the petroleum industry's activities; (4) the Health Department regulates the water supply and sewage disposal; (5) the Department of Agriculture regulates pesticides, and (6) the Department of Wildlife Conservation. (Rees-Florida)

### 1104-A10, A12, C3, F3

### FISH AS POTENTIAL VECTORS OF HUMAN BACTERIAL DISEASES,

Fort Detrick, Frederick, Md. Medical Sciences Labs.
Werner A. Janssen.
1970. 7 p, 40 ref.

Descriptors: Diseases, Vectors (Biology), Pathogenic bacteria, Pseudomonas, Fish, Oysters, Crabs, Clostridium, Salmonella, Shigella, E. coli, Bioindicators, Bullheads, White perch, Mycobacterium.
Identifiers: Aeromonas, Staphylococcus, Pasteurella, Leptospira.

The similarities between pathogens which infect humans and those found in fish suggests that fish may act as passive or active hosts for pathogens which infect man. Review of the relatively few studies conducted in the past and the author's own experience demonstrate the feasibility of this thesis. Because of the increased use of fish for food, the contamination of water, especially with human wastes, and the contact between man and the aquatic environment, research on this subject should be expanded. (Little-Battelle)

### 1105-A4, F2

### RULE AND REGULATION FOR THE REGISTRATION OF FEEDLOTS.

Nebraska Water Pollution Control Council, Lincoln.

Nebraska Water Pollution Control Council, Lincoln, Neb, nd, 2 p.

Descriptors: *Nebraska, *Water pollution control, *Waste disposal, *Domestic animals, Legislation, Feeds, Water pollution sources, Water policy, Administrative agencies, Regulation, Programs, Standards, Streams, Rivers, Pollution abatement, Administration, Cattle, Poultry, Water fowl, Animals, Legal aspects, Waste disposal, Farm wastes.

The Nebraska Water Pollution Control Council is empowered to effectuate a comprehensive program of water pollution control. Feedlot registration is a necessary portion of an overall waste disposal inventory. For clarity in implementing this Regulation, the word 'feedlot' is defined as the confined feeding of food, fur, or pleasure animals in buildings, lots, or ponds not normally used for raising crops or grazing animals. The confined feeding of enumerated animals, when grouped in numbers herein specified, shall come under this regulation. Any confined feeding within 500 feet of any watercourse also comes within the provisions of the Regulation. Registration of existing feedlots, prior to July 1, 1968, and proposed feedlots, at least sixty days prior to construction, is mandatory. Such registration must be accomplished on forms supplied by the Council. Detailed information must be provided on each feedlot. A failure to register is made punishable by statutory penalties. (Rees-Florida)

### 1106-A1, A4, A5, A9, B1, F4

**MANAGING OUR ENVIRONMENT.**
Agricultural Research Service, Washington, D. C.

Dept of Agriculture, Washington D C, Agriculture Information Bulletin No 351, April 1971. 48 p.

Descriptors: *Management, *Environment, *Agriculture, *Water pollution control, Sediments, Farm wastes, Nutrients, Phosphorus, Algae, Nitrates, Water reuse, Salinity, Pesticides, Livestock, Waste disposal, Oxidation lagoons, Dehydration, Runoff, Radioactivity, Fallout, Biocontrol, Insect control, Irrigation, Predation, Parasitism, Insect resistance, Insect attractants, Precipitation (Atmospheric), Genetics, Erosion control, Air pollution, Trees.
Identifiers: Feedlots, Composting, Plant residues, Recycling food, Processing wastes, Pathogens, Bioenvironmental controls.

Some of the major problems in agricultural research dealing with new and older methods of environmental management are described in an effort toward interesting the public in preservation of the quality of our environment. General material is presented under the subjects 'Protecting land, water and waterways,' 'Management of farm wastes,' 'Recycling food processing wastes,' 'New ways to fight pests--alternatives to pesticides,' and 'A green world--a clean world.' Among the problems discussed are prevention of animal wastes reaching waters, phosphorus from human wastes and detergents, multiple water reuse, and salinity in irrigated lands of the Southwest. Scientists are trying to prevent pesticide residues in soil and water and avoid pesticide overuse. Fallout from nuclear weapon testing calls for various decontamination treatments; food processing waste disposal and recycling is described, and recovery of potable water from seawater by reverse osmosis. Alternatives to pesticides are destruction of insects and weeds by introduction of predators, parasites, and pathogens which feed on or infect pests; resistant varieties, attractants, genetic control, bioenvironmental controls, and hormone and daylight manipulation. (Jones-Wisconsin)

### 1107-A2, A3, A4, E1, E2, F1, F2, F4

**WATER POLLUTION CONTROL LEGISLATION, AGRICULTURAL RUNOFF, PART 6.**
Congress, Washington, D.C.

Hearings before the Committee on Public Works, Subcommittee on Air and Water Pollution, 92d Cong, 1st Sess. April 2, 1971. p 2515-3188, 64 fig, 208 tab, 9 chart, 420 ref.

Descriptors: *Agricultural chemicals, *Chemical wastes, *Farm wastes, *Livestock, *Water pollution sources, Missouri, Kansas, Runoff, Fertilizers, Pesticides, Waste disposal, Nitrates, Leaching, Salts, Associated costs, Eutrophication, Legal aspects, Social aspects, Nutrients, Bodies of water, Legislation, Federal government.
Identifiers: *Agricultural runoff.

Testimony was heard by the Senate Subcommittee on Air and Water Pollution, as part of its investigation into the effects of agricultural waste runoff on water. Agricultural operations in Kansas and Missouri are examined. Agricultural water pollution results primarily from surface runoff of silt, animal wastes, pesticides, fertilizers, and other chemical and biological agents. The problem of concentrated animal wastes from large-scale feedlots is explored. Current methods of controlling agricultural pollution, changes needed to correct current problems, and cost impacts are covered from the viewpoint of industry, science, and elected public officials. An extensive appendix includes articles and scientific papers relating to water pollution from agricultural runoff. Methods of curtailing and preventing the discharge of concentrated organic wastes into rivers and streams are explained. The contamination of surface water from plowing under concentrated feedlot manure is discussed. The contamination of water supplies by inorganic fertilizer salts is also examined. (Grant-Florida)

### 1108-A2,A3, A4, C2, C3

**EFFECTS OF AGRICULTURAL LAND USE ON THE QUALITY OF SURFACE RUNOFF,**
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
J. I. Sewell, and J. M. Alphin.
Mimeographed paper presented at the Southeast Region Meeting of the American Society of Agricultural Engineers and Southern Section, Soil Conservation Society of America in Richmond, Virginia, February 14, 1972. 8 p, 3 tab, 7 ref. OWRR A-021-Tenn (1).

Descriptors: *Water quality, Feedlots, Lagoons, *Tennessee, *Farm wastes, On-site investigations, Water pollution sources, *Land use, Nitrates, Phosphates, Dissolved oxygen, Coliforms, Bacteria.

Surface water samples form twenty-four sites at four locations in Tennessee were analyzed to determine the effects of agricultural land use on the quality of surface runoff. The results showed that bacterial counts and chemical concentrations of surface water samples were dependent on land-use activities; however, the most important factors affecting the measured levels of these parameters were the location of the sampling points with reference to the source of the pollutants, dilution of the pollutants, and the time during the runoff cycle at which samples were taken. Concentrations of livestock increased the BOD, orthophosphates, and especially the bacterial counts of surface runoff samples from the areas affected. Of thirteen agricultural sites examined on flowing streams, none had dissolved oxygen or total nitrogen levels which failed to meet FWPCA standards for public water supplies, and only one site failed to meet the bacterial criteria.

### 1109-B2, C2, D3

**AN EVALUATION OF AN ANAEROBIC LAGOON TREATING SWINE WASTES,**
Mississippi State Univ., State College. Dept. of Civil Engineering.
James H. Scarborough.
Master's Thesis, August 1970. 92 p, 24 fig, 8 tab, 44 ref.

Descriptors: *Farm wastes, *Hogs, *Anaerobic digestion, Slurries, Confinement pens, Farm management, Waste treatment, Sampling, Biochemical oxygen demand, Chemical oxygen demand, Phosphate, Hydrogen ion concentration, Alkalinity, Nitrogen, Sedimentation, Water pollution sources, Odor, *Oxidation lagoons, Waste water treatment.
Identifiers: New-light swine farm.

Interest in the treatment of livestock wastes has grown in recent years due to concentration of livestock in areas where they are raised for commercial use and the migration to urban areas of those who are seeking a less polluted habitat. In Mississippi, an aerobic lagoon which treated swine wastes was studied for quality of incoming waste and effluent, as well as performance under varying temperatures. Random grab samples of influent and effluent were taken approximately once a week from February 10 to April 23, 1970, and again on May 19, 1970. The samples were studied for biochemical oxygen demand, chemical oxygen demand, phosphorous expressed as phosphate, volatile solids, total solids, most probable number of coliform bacteria per 100 ml, alkalinity, and total nitrogen. Results showed that anaerobic lagoons would reduce the pollutional characteristics of the waste considerably. The lagoon still contained an appreciable amount of oxygen demanding material and still caused highly odorous conditions, indicating that the effluent should receive further treatment. Perhaps anaerobic lagoons should only be used as a preliminary step rather than a complete treatment facility and should be followed by other means of treatment prior to the adequate and safe disposal of the effluents. (Atkins-Texas)

### 1110-A4, A11, A12

**LAKE TERMINOLOGY: WATER BLOOM,**
Michigan State Univ., East Lansing.
J. O. Veatch, and C. R. Humphrys.
Bull Mich Agric Coll Exp Station, East Lansing, p 241, 1964. 1 fig.

Descriptors: *Eutrophication, Algae, Ducks, Color, Fishkill, Lakes, Odor, Toxicity, Water pollution effects, Water quality, Cattle.
Identifiers: *Definitions, *Water bloom, Toxic algae, Recreational use.

This lexicon of lake terminology defines a water bloom as: 'A prolific growth of plankton. A bloom of algae may be so dense that it imparts a greenish, yellowish, or brownish color to the water. The growth may be so concentrated in some parts of a lake that it interferes with swimming and boating. The algae not only imparts a disagreeable odor, but it may be a cause of fish mortality, and some species may be poisonous to cattle and ducks and a menace to drinking water supplies.' This entry includes an aerial photograph of an algal bloom concentrated in bay of a lake. (Eichhorn-Wis)

### 1111-A9, A11, A12, F3

**POLYCHLORINATED BIPHENYLS,**
David B. Peakall, and Jeffrey L. Lincer.
BioScience, Vol 20, No 17, p 958-964, September 1, 1970. 1 fig, 2 tab, 62 ref.

Descriptors: *Chlorinated hydrocarbon pesticides, *Food chains, *Pesticide toxicity, Physical properties, Chemical analysis, Persistence, Absorption, DDT, Chemical properties, Plastics, Paints, Rubber, Resins, Gas chromatography, Spectrophotometry, Mallard duck, Poultry, Songbirds, Wading birds, Mussels, Herrings, Path of pollutants, Water pollution sources, Water pollution effects.
Identifiers: *Biological magnification, *Aroclors, *Polychlorinated biphenyls, Chemical structure.

The structural and physical properties, uses, analytical methods, toxicology, levels in nature, and biological magnification of PCBs, and the ratio of DDT to PCB in the environment are summarized. Although nothing is known about the biological decomposition of PCBs, it is likely that they are more stable than DDT and its metabolites and thus have a tendency to accumulate up the food chain. No figures on the amount of these materials produced annually are available. Analysis of PCBs has been carried out by means of a combination of high resolution gas chromatography and mass spectrometry. Nitration and saponification have been used to separate PCBs from other residues for analysis. Although several studies have been carried out on the toxicology of PCBs, toxic levels are still largely undefined. Studies have shown, however, that there are striking alternations in the internal organs of some mammals and birds. Data taken from several studies indicate that the PCBs are capable of biological magnification of the food chain. Because of the apparent danger of these materials it is necessary to discover the major sources of their escape into the environment. Sixty-two references have been cited in this summary. (Little-Battelle)

### 1112-A2, B2, B4, C2, C3

**CATTLE FEEDLOT RUNOFF NATURE AND BEHAVIOR,**

Kansas State Univ., Manhattan. Dept. of Bacteriology.
J. R. Miner, L. R. Bernard, L. R. Fina, G. H. Larson, and R. I. Lipper.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, and 5, 1966, p 834-847. 9 fig, 9 tab, 10 ref.

Descriptors: *Water pollution sources, *Surface runoff, *Cattle, *Farmwastes, Rainfall intensity, Chemical properties, Bacteria, Nitrogen, Coliform, Streptococcus, Laboratory tests, Data collection, Analysis.
Identifiers: Feedlot.

Stormwater runoff is becoming recognized as an important water pollutant. Runoff from cattle feedlots is particulary strong. Three types of experiments were conducted to evaluate the characteristics and behavior of feedlot runoff. Two feedlots (0.05 acres each) were constructed, one with a dirt surface and the second with a concrete surface. Ten head of cattle were maintained in each lot and rainfall was simulated by a series of sprinklers. The runoff was collected and tested for chemical and bacterial contamination. Tray experiments were conducted to determine bacteriological changes in manure lying on the feedlot surface. Anaerobic bottle studies were made to determine the effects of storage in deep ponds. Cattle feedlot produces a high strength waste with considerable quantities of nitrogen. Waste strength increased with low rainfall rates, warm weather and moist lot conditions. Runoff from the concrete surface lot was nearly twice as strong as from the unsurfaced lot. The bacterial nature of the stored feedlot runoff and litter changed continuously. Changes were a function of temperature and storage time. The fecal coliform: fecal streptococcus ratio does not appear to be an entirely reliable tool to identify the cause of an observed water pollution problem. (Goessling-Texas)

### 1113-B2, C2, D1, D2, D3

**AERATED LAGOON TREATMENT OF LONG ISLAND DUCK WASTES,**

Cornell Univ., Ithaca, N.Y. Dept. of Civil Engineering; and Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
Raymond C. Loehr, and Dennis D. Schulte.
2nd International Symposium for Waste Treatment Lagoons, June 23-25, 1970, Kansas City, Missouri, p 249-258. 7 fig, 2 tab, 11 ref.

Descriptors: *Oxidation lagoons, *Farm wastes, Pilot plants, Chlorination, Phosphates, Mixing, Coagulation, Flocculation, Dissolved oxygen, Biochemical oxygen demand, Aerobic conditions, Anaerobic conditions, Cost analysis, Design criteria, Mathematical models, Waste water treatment.
Identifiers: *Aerated lagoons, *Duck wastes.

Laboratory treatability studies were conducted in 1963 to determine the feasibility of treating duck wastes in a number of treatment systems. Pilot scale tests were then run on a aerated lagoon system in 1967. The pilot plant had a 250,000 gallon capacity, an 8 ft depth, and a 5 HP floating aerator. 35% of the duck waste water systems subsequently installed provided in excess of 90% BOD reduction, and 50% provided in excess of 85% BOD reduction, with aerator power relationships ranging from .008 to .04 nameplate horsepower per 1000 gallons. These systems included aerated lagoons, settling ponds, and chlorination. Studies are presently being conducted on the new methods of phosphate removal, with some type of removal to be implemented as soon as possible.
(Lowry-Texas)

### 1114-A6, B2, C2, D3, E2, F1

**ANIMAL MANURE LAGOONS, A QUESTIONABLE TREATMENT SYSTEM,**

Samual A. Hart.
2nd International Symposium for Waste Treatment Lagoons, June 23-25, 1970, Kansas City, Missouri, p 320-324. 1 tab, 19 ref.

Descriptors: *Farm wastes, *Oxidation lagoons, Organic loading, Infiltration, Evaporation, Percolation, Aeration, Oxygenation, Odors, Sprinkler irrigation, Aerobic conditions, Anaerobic conditions, Biochemical oxygen demand, Waste water treatment.
Identifiers: Aerated lagoons.

Both oxidation lagoons and oxidation ditches can be of significant value to the agriculture industry. First introduced in the early 1950's, these lagoons proved to be inexpensive to build and offer a minimum of maintenance. However, this system must be carefully designed in order to provide adequate treatment of agricultural wastes, and this care in design has not been inherent to lagoons in the past. Comprehensive field studies on cow manure have indicated that 60 ft to the third power of aerated lagoon volume is necessary to treat 1 lb BOD 5/day. In between totally mixed and aerated lagoons, and conventional oxidation lagoons are various degrees of anaerobic and aerobic treatment. Similar studies conducted on hog wastes fixed loading rates at 12 ft to the third power/400 lb pig as being capable of providing sufficient treatment. Oxidation lagoons were also studied, with loading rates of 30 ft to the third power/lb BOD5. Costs for the oxidation ditch treatment are $6 per hog of aeration equipment and $.005 per hog per day of power requirements. Overall, oxidation lagoons and ditches, and aerated lagoons can provide sufficient treatment if properly designed and maintained. (Lowry-Texas)

### 1115-A4, A5, B2, C2, D3, E2

**CONTROL OF NITROGEN FROM ANIMAL WASTE WATERS,**

Cornell Univ., Ithaca, N.Y. Dept. of Civil and Agricultural Engineering.
Raymond C. Loehr.
Proceedings 12th Sanitary Engineering Conference on Nitrate and Water Supply: Source and Control, February 11-12, 1970, University of Illinois, Urbana: Illinois University, College of Engineering Publication, p 177-189, 1970. 13 p, 4 fig, 1 tab, 22 ref. FWQA Project WP-1493.

Descriptors: *Farm wastes, *Nitrogen compounds, *Waste treatment, *Nitrification, *Denitrification, Confinement pens, Farm lagoons, Organic wastes, Waste water treatment, Biodegradation, Aeration, Aerobic treatment
Identifiers: *Nitrogen removal.

The trend in recent years for the confinement feeding of livestock and for increased numbers of animals per production unit results in highly concentrated, low-volume waste flows which represent a pollutional hazard to ground- and surface waters. The pollutional contribution from these activities is manifested by excessive nutrient concentrations, chiefly high levels of nitrogen, microbial impairment of surface waters, release of contaminants that complicate subsequent water treatment operations, and depletion of dissolved oxygen in surface waters. Control of such wastes commences with containment. The microbial synthesis which occurs during containment reduces nitrogen levels to a certain extent. Further removals can be accomplished by ammonia stripping using diffused aeration or by nitrification-denitrification. The most suitable method of disposal for treated wastes is on the land, where the remaining nutrients can be incorporated into crops. (Knapp-USGS)

### 1116-A4, A5, B2, B3, B4, D1, D2, D3, E2

**MANAGING LIVESTOCK WASTES TO CONTROL POLLUTION,**

Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
James A. Moore.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 29-34, June 1969. 2 tab.

Descriptors: *Pollution control, *Organic loading, *Cattle, *Hogs, *Sheep, *Farm wastes, Water pollution sources, Water quality, Waste disposal, Minnesota, Nitrogen, Phosphorus, Potassium, Aerobic treatment, Water pollution control..
Identifiers: *Manure processing, *Manure disposal, Livestock industry, Manure storage, Oxidation ditch.

High costs and larger quantities of inert and biologically stable materials prohibit many municipal waste treatment systems being used for animal waste disposal. No system has been designed to remove nitrogen and phosphorus in animal wastes. Four steps in the management of manure are suggested: (1) collection, (2) processing, (3) storage, (4) utilization or disposal. Drying manure simplifies sanitation problems because it is stable, relatively odorless, and breeds few flies. Energy required for drying limits method. Anaerobic lagoons are a popular method for stabilizing organic matter, because disposal problems are mostly eliminated. Animal waste can be treated in aerobic oxidation ponds with oxygen supplied by algae and natural reaeration supplemented by mechanical aeration. Impervious-bottom tanks and storage areas should be considered to prevent nutrient leaching during extended holding periods. Although economically non-competitive, more effort to dispose animal waste as fertilizer would alleviate the problem and prove beneficial to soils. (Bannerman-Wisconsin)

### 1117-A4, A6, A11, A12, C2, E1

**WATER POLLUTION BY NUTRIENTS-SOURCES, EFFECTS AND CONTROL, PAPERS PRESENTED AT 1966 ANNUAL MEETING OF MINNESOTA CHAPTER SOIL CONSERVATION SOCIETY OF AMERICA.**

Minnesota Univ., Minneapolis. Water Resources Research Center.
WRRC Bulletin 13, Minnesota Water Resources Research Center, June 1969. 79 p. OWRR Project A-999-MINN.

Descriptors: *Water pollution sources, *Water pollution effects, *Eutrophication, *Nutrients, Algae, Fish population, *Water pollution control, Farm wastes, Municipal wastes, Septic tanks, Recreation

wastes, Water quality.
Identifiers: *Nutrient sources.

The Bulletin includes the papers presented at a conference on 'Nutrient Pollution - Sources, Effects and Control' held in Minneapolis, Minnesota on January 8, 1969. The conference was planned as the Annual Meeting of the Minnesota Chapter, Soil Conservation Society of America. The papers, all individually abstracted, include the following titles: Nutrients and Other Forms of Pollution, Diagnosing Pollution in Lake Minnetonka, Effect of Eutrophication on Fish and Related Organisms, Health Aspects, Surface and Groundwaters, Animal Waste Disposal Problems and Trends in Minnesota, Managing Livestock Wastes to Control Pollution, Runoff and Sediment as Nutrient Sources, Controlling Nutrients and Organic Toxicants in Runoff, Treatment of Municipal Wastes, Septic Tank Effluents, Water Pollution in Recreational Areas - Sources and Control, and Setting Water Quality Standards and Regulating Nutrient Sources, Implementing Pollution Control.

## 1118-A2, A3, A4, A5, C2

**WATER QUALITY MANAGEMENT PROBLEMS IN ARID REGIONS.**
Robert S. Kerr Water Research Center, Ada, Okla. Treatment and Control Research Program.
James P. Law, Jr., and Jack L. Witherow, Editors. Federal Water Quality Administration Water Pollution Control Research Series 13030 DYY 6/69, October 1970. 105 p. FWOA Program 13030 DYY.

Descriptors: *Conferences, *Water quality, *Water pollution sources, *Water pollution control, *Arid lands, Irrigation, Agriculture, Evaporation, Salinity, Farm wastes, Surface waters, Groundwater, Planning, Irrigation effects, Wastes, Nutrients.

An international conference entitled 'Arid Lands in a Changing World' sponsored by the American Association for the Advancement of Science Committee on Arid Lands and the University of Arizona, was held at Tucson in June, 1969. The Federal Water Quality Administration provided financial support for the conference and solicited papers to be presented in the Water Management and Salinity and Desalinization sessions. This report presents a selected group of the papers presented at those sessions which should benefit those concerned with water quality management problems in arid regions. The title of the papers included in this report are as follows: nitrate removal from agricultural waste water; the effects of salinity standards on irrigated agriculture in the Colorado River basin; problems of pollution of irrigation waters in arid regions; water quality requirements and re-use of waste water effluents; salinity control in return flow from irrigated areas--a demonstration project; water quality control problems in inland sinks; natural pollution in arid land waters; distillation of waste waters: a water resource for arid regions; and animal waste runoff--a major water quality challenge. (Woodard-USGS)

## 1119-B2, D3

**TREATMENT OF AQUEOUS AGRICULTURAL WASTES FOR CLEAN WATER AND FOR MICROBIAL PROTEIN PRODUCTION,**
Iowa State Univ., Ames. Dept. of Chemical Engineering.
G. T. Tsao. Iowa State Water Resources Research Institute, Ames, Completion Report ISWRRI-33, Engineering Research Institute ISU-ERI, Ames-99959 April, 1971, 34 p, 27 fig, 12 ref. OWRR Project A-032-IA (6).

Descriptors: Oxygen, Absorption, *Foaming, *Aeration, *Cytological studies, Farm wastes, Waste water treatment, *Biological treatment.
Identifiers: Waldorf aerator, Cell growth, *Whey.

Cheese whey containing 35,000 ppm BOD is the most concentrated liquid waste that can be found in large quantities. It foams excessively when bubbled with gas. Cheese whey was successfully treated in a Waldhof aerator by Saccharomyces fragilis. This yeast can reduce about 85% of the BOD and produce single cell protein. A batch as well as a continuous growth process of this yeast was successfully developed. A fundamental study on the transient and steady state behavior of cell growth was also conducted. Through computer simulation, it was possible to predict growth pattern in batch and continuous processes. Oxygen is important in any aerobic biological process. The Waldhof aerator not only provides good aeration for yeast growth, but is also capable of handling highly foamy liquors like whey through its foam recycling mechanism. A sysmetical study on the working mechanisms of a Waldhof aerator was conducted. Foam fractionation of the yeast and other microbiological cells was also studied. Foam decay was found to follow a second-order rate pattern. A theoretical investigation was conducted on gas-liquid interfacial oxygen absorption. The effect of viable microbiological cells that consume the transferring solute on the rate of oxygen absorption was analyzed.

## 1120-A3, A4, C2

**SOURCES OF PHOSPHATE, AMMONIUM AND NITRATE CONTAMINATION IN SOME CENTRAL NEW JERSEY STREAMS,**
Rutgers-The-State Univ., New Brunswick, N.J. Dept. of Soils and Crops.
Aytekin Bilgin.
M Sc Thesis, Rutgers University Graduate School, March 1971. 113 p, 29 fig, 7 map, 1 tab, 60 ref. OWRR Project A-027-NJ (1).

Descriptors: *New Jersey, *Water pollution sources, *Pollutants, *Phosphates, *Nitrates, Surface runoff, Leaching, Sewage disposal, Chemical wastes, Domestic wastes, Farm wastes, Industrial wastes, Fertilizers, Ammonia, Nitrogen cycle, Nutrients, Nitrification, Decomposing organic matter, Eutrophication, Balance of nature, Biochemical oxygen demand, Aquatic productivity.
Identifiers: *Middlesex County (N J), *Somerset County (N J), *Mercer County (N J), New Brunswick (N J), Princeton (N J).

A study was made from April to October 1970 of pollution in seven streams located in Middlesex, Somerset, and Mercer Counties, New Jersey. The objective of this investigation was to determine the origin, source, and concentrations of phosphate, ammonium, and nitrate polluting the streams. The following were the areas studied: Beaverdam Brook (E. Brunswick), Mile Run (New Brunswick), Six Mile Run (New Brunswick), Millstone River (Princeton), Rock Brook (Zion), Duck Pond Run (Princeton), and Big Bear Brook (Hightstown). Of these, Millstone River, located near a sewage disposal plant, and Mile Run, near a chemical plant, produced the highest phosphate and ammonia levels. Mile Run had the greatest BOD because of the heat and wastes polluting it. Nitrate contamination developed principally in areas where eutrophic conditions existed for some years, and where surface runoff leached out fertilizer residues from suburban lawns and cultivated agricultural soils. Moderate nitrate contamination was seen in Six Mile Run, Big Bear Brook, and Duck Pond Run. The highest nitrate level occurred in Beaverdam Brook where the adjacent watershed had been completely altered some 5 years earlier by bulldozing and grading operations. This activity completely destroyed the original soil profile and broke up and buried the former organic layer so that mineralization and nitrification was rapidly increased. (Glasby-USGS)

## 1121-A2, A3, A4, A9, A11, C2, C3, E1, E3

**WATER POLLUTION FROM LAND RUNOFF,**
Agricultural Research Service, US Department of Agriculture.
K. C. Walker, and C. H. Wadleigh.
Plant Food Rev, Vol 14, No 1, pp 2-4, 1968. 3 p, 1 photo.

Descriptors: *Runoff, *Water pollution, Infiltration, Sediments, *Sediment yield, *Nutrients, Eutrophication, Inorganic compounds, Nitrates, Phosphates, Calcium, Magnesium, Fertilizers, Agricultural chemicals, Fishkill, Pesticides, Endrin, Irrigation, Acid mine water.
Identifiers: *Livestock wastes, Runnels, Feedlots, *Land runoff, Manure recycling, Bacterial pollution.

Contributions of agricultural activities to the pollution of runoff is surveyed, and it is found that sediment is by far the most prevalent entity that impairs water quality. Of the average annual precipitation, 30% becomes runoff and less than 1% infiltrates deeply. Sediment yield in the Mississippi basin averages 390 tons annually per sq mi. Large amounts of nutrients are lost with sediments. For example, the load per yr of nitrogen is 500,000 tons; phosphate, 750,000; calcium, 5,400,000; magnesium, 2,400,000; and livestock wastes, 1.6 billion (1965). Associated wastes brought the annual total to 2 billion tons. Organic waste problems are severe. 50,000 head of beef cattle produce as much waste as 600,000 people; therefore, serious economic and engineering planning is necessary for disposing of manure or for recycling it for fertilizer use. Major fish kills have occurred because of feedlot runoff, which with other farmland runoff contains high nitrates and phosphates. Pesticides usually are present but in low concentrations. Irrigation increases the natural salts content of runoff. Acid mine drainage is a problem in the Ohio River Watershed

## 1122-A3, A4, A5, A8, A11, A12, B2, B3, C2, E2

**NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,**
Wisconsin University, Madison.
S. Witzel, E. McCoy, O. J. Attoe, L. B. Polkowski, and K. T. Crabtree.
Water Resources Center, University of Wisconsin, Technical Completion Report. December 1968, 65 p. 14 tab., 12 fig., 27 ref.
1968, 65 p. 15 tab., 12 fig., 27 ref. OWRR Project B-004-Wis.

Descriptors:: *Domestic animals, *Wastes, fertilizers, *Essential nutrients, *Nitrification, crops, toxicity, soil porosity, irrigation, ground water, runoff, frozen ground, soil erosion, water pollution, Dentrification, phosphorus compounds, algae, aquatic plants.

Autotrophic and heterotrophic nitrification have been studied with 191 samples of shallow water from streams, farm ponds and adjacent soils. Of 47 chosen for repeated tests, 45 produced no sub 2-N ranging 5-154 microgram/ML. Av. 48 microgram/ML. Only 2 produced no sub 3-N at 33 and 46 microgram/ML. Of 167 stock cultures of soil fungi, the main producers were in the aspergillus flavus-oryzae and A. Wentii groups (75% yielded 65-100 micrograms of no sub 3-N) and the penicillium genus (21 of 24 species yielded 7-19 microgram/ML of no sub 3-N from no sub 2-N, not from organic N). Nitrifiers of no sub 2, no sub 3 type were found in 5 other genera. Residual no sub 3 following crop maturity migrates downward from 12 inches to aquifer depth at 20 feet over winter on waupun and plainfield soils, respectively. One Wisconsin community had 86 wells with 34.5% unsafe containing high no sub 3 and another had 550 wells with 1/3 unsafe. Surface waters received less than 5.7 lb. N and 2.53 lb. p. per A. in flood flows from a 1346 A. watershed; 3.62 lb. N and 1.14 lb. p per A. from 3 farm areas totaling 246 A. Lancaster plots receiving 15 tons dairy cow wastes per A. lost 19.8% more N and 11.3% more P when applied on frozen ground in a year of high winter runoff.

### 1123-B2, B3, B4, D1, D2, D3

**A FEASIBILITY STUDY OF A LIVESTOCK WASTE DISPOSAL SYSTEM INVOLVING THE REUSE OF WATER,**
North Dakota State Univ., Fargo.
George L. Pratt.
Research Project Technical Completion Report to Office of Water Resources Research, December 1968, Washington, D. C. 24 p, 11 tab, 2 ref. OWRR Project A-001-NDAK.

Descriptors: *Water reuse, Stock water, Domestic animals, *Farm wastes, Potable water, Solid wastes, Urine, Water pollution, Aeration, Aerobic treatment, Biological treatment, Coagulation, Filtering systems, Filtration, Flocculation, Oxidation, Waste storages, *Waste water treatment, Water purification, Water treatment.

Separating solid materials from liquid wastes that have been removed from a livestock barn can be accomplished in several ways. In trials at the North Dakota Agricultural Experiment Station settling tanks and sand filters were evaluated. In one phase of the work treatment of overflow from a settling tank that collected beef waste was emphasized. No treatment, aeration, and treatment with aluminum sulfate (alum) were tested for the settling tank overflow. The settling tank removed the bulk of the solids. Alum treatment of the overflow was effective in reducing total solids to the point where it was nearly feasible to provide final treatment. In the second phase of the work a slow sand filter was tested under controlled conditions to determine its adaptability for final treatment of reclaimed water. Tests were run at three temperatures, 45 deg F, 70 deg F, and 100 deg F. Controlled amounts of organic material were added to the influent of the filter. The filter was easily managed and adaptable to a wide range of conditions. Its performance was better at 70 deg F than at 45 deg F or 100 deg F.

### 1124-A3, A4, A5, A8, A12, B2, B3, C2, E1, E2

**EFFECT OF VARIOUS FACTORS ON MOVEMENT OF NITRATE NITROGEN IN SOIL PROFILES AND ON TRANSFORMATIONS OF SOIL NITROGEN,**
Wisconsin University, Madison.
R. J, Olsen.
University of Wisconsin, Water Resources Center, Report 1969. 79 p. OWRR B-004-Wis.

Descriptors: *Nitrification, *Soil nitrogen, *Public health, *Soil leaching, Groundwater, Soil profiles, Water table, Surface runoff, Farm wastes, Aerobic conditions, Incubation.
Identifiers: Lake Europhication, *Soil phosphorus, Alfalfa-Bromegrass, Spring thaws, Fertilizer-nitrogen.

There is increasing evidence that agriculture is contributing to the increase in nitrate-nitrogen in streams, lakes, and domestic water supplies. High amounts of nitrate-nitrogen in water are a health hazard and contribute to lake eutrophication. Methods by which nitrogen may enter the water from agricultural sources include the leaching of nitrate-nitrogen through the soil profile to the water table and surface runoff, especially during spring thaws from manure applied to frozen soil during the winter. The data obtained from field experiments indicate that pollution of groundwater with nitrate-nitrogen can be limited by avoiding excessive rates of fertilizer nitrogen; providing a crop cover on the soil during the growing season; use of hay crops, such as alfalfa-bromegrass, in rotation with corn or other crops receiving fertilizer nitrogen; and not permitting unprotected manure to accumulate during the time of year when leaching can occur. Recovery of fertilizer nitrogen by three successive corn crops and as soil in organic nitrogen following the last crop ranged from 73 to 88 percent. The average concentration of nitrate-nitrogen in the soil solution at the lowest profile depth sampled ranged from 14 ppm for virgin soils to 21 ppm for manure contaminated soils and to 33 ppm for cultivated soils. Rate of nitrification was directly related to the rate of manure application, presence of aerobic conditions, period of incubation, and soil phosphorus. The average recovery of nitrogen by chemical analysis of the soil receiving the higher manure rates after 37 weeks of incubation ranged from 24% for anaerobic conditions to 73 to 80 percent for the aerobic conditions. These data suggest that where animal manure is not to be used as a fertilizer, lagooning of the manure under anaerobic conditions may be an effective method of disposal with a minimum risk of water pollution. (Olsen - University of Wisconsin).

### 1125-A3, A4, E2, F1

**ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA,**
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
Evan R. Allred.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 22-28, June 1969. 2 fig, 3 tab.

Descriptors: *Livestock, *Wastes, *Farm wastes, Organic wastes, Minnesota, Biochemical oxygen demand, Farms, Pollutants, Water pollution sources, Eutrophication.
Identifiers: *Livestock waste disposal, Broiler farms, Livestock wastes comparison, Feedlots, Manure production, Food production wastes, Projected livestock farms, Wastes management.

The growing problem of animal waste disposal resulting from the trend toward concentration of livestock on fewer farms is discussed. Data compiled in Minnesota indicates large percentage of these farm animals are on feed and in confinement. The problem will accelerate as herds grow larger to meet future population demands. By 1980 there is a projected 10-fold increase in the average hog and feed-cattle herd size in Minnesota. Three reasons given for failure to solve animal waste disposal problems are: (1) reluctance to monetary expenditures on adequate methods, (2) because the problem has been considered unrelated to other parts of society, and (3) approaches have been used that are only applicable to other types of waste. Cost involved and the enormity of the problem are realized when data presented indicate a 250,000 bird poultry enterprise has a biochemical oxygen demand waste equivalent to a city population of 25,000. Eutrophication is increased by spreading manure on frozen ground and the consequent runoff in spring thaw. Since the cost of a treatment plant and storage is prohibitive to individual farmers, it is concluded that no immediate, simple solution is in sight. (Bannerman-Wisconsin)

### 1126-A1, A4, A8, C2, F6

**SAVANNAH RIVER ECOLOGY LABORATORY. ANNUAL REPORT, 1971.**
Georgia Univ., Athens. Inst. of Ecology.
Robert J. Beyers, I. L. Brisbin, D. C. Coleman, J. B. Gentry, and J. W. Gibbons (editors). August 1971. Parts 1 and 2. 420 p. AT (38-1)-310.

Descriptors: *Boron, *Nutrient requirement, *Cycling nutrients, *Radioactivity effects, Water pollution effects, Ecosystems, Thermal pollution, Radioecology, Southeast U.S., Microorganisms, Bass, Ecology, Snakes, Poultry, Rodents, Aquatic habitats, Aquatic plants, Amphibians, Turtles, Aquatic life, Path of pollutants, Reservoirs, Streams, Soil-water-plant relationships, Absorption.

Work at the Savannah River laboratory is reported which includes basic ecology (16 projects), radioecology (3), ecosystem radiation effects (2), and thermal effects on fish (2). Analysis of southeastern United States surface waters for boron showed levels which were usually less than 100 ppb. It appears that a higher level in most streams is by leaching of rocks and soil, as compared with the lower level in large reservoirs which is comparable with the level in rainfall (except in cases of salt water intrusion). Other studies include: radiation effects on ecosystems involving (respectively) microorganisms, fish, and broiler chicks; and nutrient studies in ecosystems involving aquatic macrophytes, harvester ants, an old-field mouse, small mammals, snakes, mosquitofish, turtles, and lizards. (Bopp-ORNL)·

### 1127-A5, C2

**WHY NITRATES IN WATER SUPPLIES,**
G. E. Smith.
Hoard's Dairyman, Vol 110, No 18, p 1048-1049, September 25, 1965. 3 fig.

Descriptors: *Nitrates, Feed lots, Fertilizers, *Farm wastes, Missouri, Water supply, Water wells, Water pollution sources.
Identifiers: *Water contamination.

Studies show that 75% of Missouri's water is contaminated by nitrates, primarily from feedlots. Shallow wells are most affected, but deep ones can be if improperly cased. To solve the problem, new properly encased wells should be dug some distance from feedlots. (Marquard-East Central)

### 1128-B2, C2, D3, E4, F5

**USE OF DUCKWEED FOR WATER TREATMENT AND ANIMAL FEED,**
Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
D. D. Culley, Jr., and E. A. Epps.
Journal Water Pollution Control Federation, Vol 45, No 2, p 337-347, February, 1973. 1 fig, 5 tab, 28 ref.

Descriptors: *Farm wastes, Waste water treatment, Farm lagoons, Nutrient removal, Feeds, Livestock.
Identifiers: *Duckweed, Lemnaceae.

This scientific study was established to search for aquatic plants suitable for nutrient reduction in animal waste lagoons and for utilization in animal feeds. Criteria for evaluating the aquatic plants are given. Chemical composition of plants from the family lemnaceae are shown in tables based on eight test sites. Duckweed shows great potential, but minor problems include toxic buildup and excess water content. (Marquard-East Central)

### 1129-A2, B2, C1, D1

**BEEF CATTLE FEEDLOT RUNOFF, SOLIDS TRANSPORT AND SETTLING CHARACTERISTICS,**
Nebraska Univ., Lincoln.
C. B. Gilbertson, J. A. Nienaber, T. M. McCalla, J. R. Ellis, and W. R. Woods.
Transactions of the ASAF (American Society of Agriculture Engineers), Vol 15, No 6, p 1132-1134, 1972, 6 fig, 8 ref. Support in part by EPA.

Descriptors: *Feed lots, Runoff, Continuous flow, *Farm wastes, Cattle, *Waste water treatment.
Identifiers: *Solids removal systems, Batch system.

Removing settleable solids from beef cattle feedlot runoff requires a working knowledge of the relationships between precipitation, runoff, solids, transport, and settling of the transported solids. The authors give physical descriptions of the working area and develop estimating equations which can be used to assist in design of solids removal systems in geographic areas with similar climatic and feedlot conditions. Two systems, a 'batch system', and a 'continuous flow' system, were constructed. In laboratory tests (Imhoff cone tests), about 40% of the total solids transported (by weight) settled in 16 to 18 minutes at zero velocity of flow. Calculated bulk density of settleable solids was 6.71 lb. per cu. ft. with a standard deviation of 3.69 lb. per cu. ft. It was recommended that an open channel should be equipped with barriers to restrict runoff flow to near zero velocity to remove sufficient solids to maintain a satisfactory condition within the holding pond. (Wetherill-East Central)

### 1130-B3, D2, E3
**THE OPCCO DRYER.**

Agricultural Engineering, Vol 53, No 6, p 16-17, June, 1972. 2 fig.

Descriptors: *Recycling, Drying, Fertilizers, *Farm wastes, *Waste treatment, Poultry, Feeds.

A solid waste management system, developed and patented by Harvey Wenger and manufactured by Organic Pollution Control Corp., has been placed on several large poultry farms to turn poultry litter into fertilizer or into a feed additive for livestock. Michigan State University's Dr. Howard Zindel and other experts feel that the dryer, used so far primarily with poultry manure, can successfully handle all forms of animal wastes plus packing house offal, vegetable and fruit peel and pulp, and municipal sewage. Requiring an area of about 20-40 feet, the 40 ton per day unit operates on either natural or LP gas. Plans for developing other power supplies are being studied. The drying process is described and a schematic of the flow path is shown. The process is not inexpensive, but it does supply a solution to the waste problem. (Wetherill-East Central)

### 1131-A2, A11, B1
**FIVE FEEDING SYSTEMS COMPARED.**
Feedlot Management. p 34-37, January, 1971. 8 fig.

Descriptors: *Feed lots, Performance, Runoff, *Farm wastes, Cattle, Confinement pens.
Identifiers: Animal density, Open lot, Open shed, Cold barn, Warm barn.

Preliminary results are given on the influence of various housing systems on beef cattle and the effect of animal density on feedlot performance. It is indicated that housed confinement should be used to capacity and maintained year round for maximum benefits. Housed confinement tends to control illness and high density does not seem to jeopardize health or feed efficiency. Advantages and disadvantages are given for each type of housing studied. The five types of housing are open lot, open shed, manure pack shed, cold barn and warm barn. All five systems are designed to contain all animal wastes. (East Central)

### 1132-B5, E1, E2, E3, F1
**THE GREAT MANURE DILEMMA,**
J. Gerstner.
The Furrow, p 1-2, September/October, 1970.

Descriptors: *Waste disposal, Waste treatment, Recycling, *Farm wastes, Livestock.

Disposing of animal wastes cheaply and without pollution is fast becoming one of agriculture's knottiest problems. United States livestock produce about two billion tons of liquid and solid wastes per year, enough to fill a square mile 10 feet high every day. Complicating the state of overproduction is the development of cheap commercial fertilizer. The large differences in livestock operations make one ultimate solution to manure handling doubtful, if not impossible. The characteristics of manure change with the type of animal, feed, and climate. The requirements for practical disposal vary with the operation's size, location, and amount of land available. Some methods being developed are: feeding processed manure to livestock, burying effluent, spreading and deodorizing it, and selling it. The animal waste problem is likely to prove less technical than economic. (Wetherill-East Central)

### 1133-A1, F2
**POLLUTION CRACKDOWN.**
The Furrow, p 4. September/October, 1970.

Descriptors: *Feed lots, *Regulation, Waste disposal, Recycling, *Farm wastes, Legal aspects, Livestock.

Cattle feeder George Reynolds was one of many stockmen forced to move farther away from expanding city limits. Many, like James Sinning, have faced law suits as high as $90,000 from people who moved next door after their feedlots had been established. Some stockmen are working with authorities to prevent embarrassing or costly law suits in the future. Lawsuit tips. Locate feedlots away from neighbors and streams. Ag engineer E. H. Davis says, 'Try to make friends with your neighbor, so you understand his problems and he understands yours.' (Wetherill-East Central)

### 1134-D3, E2
**FEED 'EM TRASH, CUT POLLUTION.**
Beef, p 12. July, 1971.

Descriptors: Cellulose, Brush control, *Farm wastes, *Recycling, Proteins, *Feed lots, Texas, Feeds.

Texas Tech researchers have devised a process that takes paper, manure, brush, or any substance with cellulose and converts it to protein and sugar. The product can be used for animal feed and possibly in the future for human consumption. (Marquard-East Central)

### 1135-A2, B2
**ENGINEER SAYS FEEDERS CAN HANDLE MOST POLLUTION CONTROL PRACTICES.**

Beef, p 15. July, 1971.

Descriptors: *Feed lots, Runoff, *Farm wastes, Water pollution control, Nebraska.

75% of feedlot pollution problems can be controlled by the individual. Small operators can receive help from the Soil Conservation Service while large operators must go to engineers to solve the other 25%. Nine suggestions are offered for control of runoff. (Marquard-East Central)

### 1136-B2, B4, D3
**FEEDERS HEAR WOES OF CONFINEMENT START.**

Beef, p 16-17. July, 1971.

Descriptors: Ammonia, Feed lots, Waste storage, *Farm wastes, Oxidation, Proteins, Iowa, *Oxidation lagoons, Waste water treatment, Livestock.

Problems of an oxidation ditch at Iowa State University are described. Because the start-up period was during the winter, ammonia foam resulted. Later, equipment malfunctions, protein foam, and freezing of sewage created problems. How each problem was met, is described. (Marquard-East Central)

### 1137-A4, B2, E1, E2
**REGISTRATION IS REQUIRED AS GOVERNMENT MOVES TO CONTROL WATER POLLUTION FROM LARGE FEEDLOTS,**
J. Richter.
Beef, p 20. July, 1971

Descriptors: *Feed lots, *Waste disposal, Farm wastes, Legal aspects, Water pollution control.
Identifiers: *Registration.

As of July 1, 1971, feedlots with over 1,000 head must apply for permits to discharge effluents into waterways. Smaller units, those that don't discharge from a single point source, or those that are in states of tougher control do not have to register. Agencies involved are the EPA and the Army Corp of Engineers working with the Refuse Act of 1899. (Marquard-East Central)

### 1138-A2, B2, B3, E2
**HOUSED CONFINEMENT - AN ANSWER FOR FEEDING IN NORTHERN CALIFORNIA,**
E. W. Manthey.
Feedlot Management, Vol 14, No 2, p 10-16, February, 1972. 6 photos, 1 fig.

Descriptors: *Feed lots, *Waste disposal, *Farm wastes, California, Confinement pens, Cattle.
Identifiers: Cow toilet.

Physical facilities are described and pictured for a housed feedlot that takes advantage of northern California's market and feed supply and overcomes the problem of the wet season. Construction time/cost are cut by new methods of casting concrete slotted floors in place. The pit beneath the lot is scraped continuously by a cable driven blade and disposed of on 160 acre fields by sprinkle irrigation. Rain runoff and overflow of troughs are piped to a pond. (Marquard-East Central)

### 1139-A11
**HOW WEATHER AFFECTS FEEDLOT PERFORMANCE.**

Feedlot Management, Vol 13, No 2, p 38-39. February, 1971.

Descriptors: *Mud, *Rain, *Winds, *Feedlots, Farm wastes, *Weather effects, Winter, Productivity.
Identifiers: Shelter.

Studies were made of weather factors associated with winter as possible causes of reduced feedlot performance. Tests were performed under artificially produced conditions. Mud was the most serious cause of reduced production. Rate of gain was reduced and the amount of feed required increased. Artificial areas are described and resulting data are given. (Fomby-East Central)

### 1140-D2, E2, E3
**ANOTHER POSSIBLE PROCESS FOR MANURE.**

Calf News, Vol 11, No 1, p 38, January, 1973.

Descriptors: Feedlots, Farm wastes, *Waste treatment, Fertilizers, Ammonia.

A theory has been developed for the processing of manure which could produce 1,000 tons of ammonia per day from the manure deposits of around 600,000 cattle. This theory proposes that the manure be partially oxidized in the presence of the correct amount of air so that a synthetic gas is produced in the correct ratios to be used for ammonia production. By this process, the manure would be converted into an easily transported fertilizer which then would go back to the land to insure high crop yields. This process may also prove an answer to the problem of cattle feedlot pollution. (Anderson-East Central)

### 1141-A5, A11, A12, C2
NITRATES DANGER FOR HUMANS, TOO,
J. E. Grundman.
Missouri Ruralist, p 24-25, February 27, 1965.

Descriptors: Feed lots, *Water wells, *Nitrates, *Farm wastes, *Missouri, Water pollution sources.
Identifiers: Nitrate cyanosis.

Nitrate contamination of well water in Missouri has been recognized in recent years. Although sampling is incomplete and data not totally conclusive, nitrate pollution appears to be closely linked with proximity to feed lots and livestock wastes, silo drainage, manure piles, and septic tanks. Infants not yet consuming solid foods are subject to nitrate cyanosis from the intake of high-nitrate water in feedlot areas. A high nitrate content also accounts for a number of maladies in livestock. Suggestions for combating nitrate pollution are given. (Anderson-East Central)

### 1142-A7, A11, A12, B2, C2, C3
WASTE-CAUSED AIR POLLUTANTS ARE MEASURED IN SWINE BUILDINGS,
Illinois Univ., Urbana. Agricultural Experiment Station.
D. L. Lebeda, and D. L. Day.
Illinois Research, p 15, Fall, 1965.

Descriptors: Ventilation, *Farm wastes, *Feed lots, Air pollution, *Hogs.
Identifiers: *Tolerance levels, Gas concentrations, Threshold levels.

The practice of collecting swine waste under partially or totally slotted floors has created a need to discover what pollutants are produced and to determine the tolerance levels of the swine to these pollutants. Untreated ponded swine wastes could hypothetically be expected to produce the same gases that untreated municipal waste creates under anaerobic conditions. A study was undertaken to determine the concentrations of ammonia, hydrogen sulfide, carbon dioxide, and airborne bacteria, with and without forced ventilation, in swine buildings with fluid manure. None of the gas concentrations approached the threshold levels for human occupancy, and research is now being planned to determine the tolerance levels of swine. (Dudley-East Central)

### 1143-A6, A11, A12, B1, C2, D2
A LOVELY NEW SCENT FOR MANURE.
Calf News, Vol 9, No 10, p 4. October, 197.

Descriptors: *Air pollution, *Sagebrush, *Farm wastes, Odor, Water pollution control.

A method of reducing manure odor with a sage brush feed additive has been discovered. This additive, which causes continuous production of volatile oils in manure and urine, seems to improve the health of the cattle with no detectable change in the taste of the beef. Plans for future research include spraying of feedlots with sage oils. The oils can be synthetically produced, but there is an abundance of natural sage. The product is not yet commercially available. (Fomby-East Central)

### 1144-A2, A4, A7, A11, B1
CONFINEMENT FEEDING - PROS, CONS, AND TIPS,
Illinois Univ., urbana.
D. G. Jedele.
Feedlot Management, Vol 13, No 1, p 21-23. January, 1971.

Descriptors: Runoff, Water pollution, Air pollution, Performance, *Feedlots, *Farm wastes, Illinois. *Confinement pens.

Advantages and disadvantages of confinement feeding are described. Aspects the feeder should investigate before beginning construction of confinement buildings are discussed. (Fomby-East Central)

### 1145-E3, F1
FEED RECYCLING SHOWING PROMISE.
Calf News, Vol 11, No 1, p 28-29, 52, January 1973.

Descriptors: Feed lots, *Farm wastes, *Recycling, *Feeds, Equipment, California, Feeds.

This is a progress report on the Feed Recycling Company, a company selling equipment that takes manure from feedlots and converts it into feeds. The equipment is capable of converting a ton of manure into sugars, fibers, and 400 pounds of protein. Initial cost for the unit is $180,000 and operating costs are five dollars a ton. The end product is worth thirteen cents a pound, which could mean returns up to $600,000 a year for wastes from a feedlot. Feeding tests for the feed are now being run at a California research station. (Marquard-East Central)

### 1146-A12, B3, C2, E3
FEEDLOT WASTE UTILIZED EFFICIENTLY BY ANIMALS.
Oklahoma State Univ., Stillwater.

Agricuture at OSU, Summer, 1972, 1 p.

Descriptors: *Farm wastes, Sheep, *Feed lots, *Proteins.
Identifiers: *Digestibility.

Feedlot dry wastes from an open feedlot were fed to sheep. Though the wastes were high in digestible protein and nutrients, a potential hazard is the entry of toxic materials into the human food chain. These first tests were limited and need to be repeated more thoroughly before any recommendations will be available. (Lee-East Central)

### 1147-A5, A8, B3, B5, E2
SOLID WASTE MANAGEMENT FOR CATTLE FEEDLOTS,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
J. M. Sweeten, W. S. Allen, and D. L. Reddell.
Cattle Feeders' Information, Publication No L-1094, (1973), 4 p.

Descriptors: *Solid wastes, *Storage, *Ultimate disposal, Groundwater, Pollutants, Aquifers, *Waste water treatment, Fertilizers, *Feed lots, Cattle, Farm wastes.

Information is presented for commercial cattle feedlots on methods and costs of solid feedlot waste management; equipment selection guidelines; and agronomic effects of applying feedlot manure to cropland. (Lee-East Central)

### 1148-A5, B2
DAIRY WASTE PONDS EFFECTIVELY SELF--SEALING,
Agricultural Research Service, Riverside Calif. Soil and Water Conservation Research Div.
S. Davis, W. Fairbank, and H. Weisheit.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper no 72-222, 10 p, 2 tab, 1 fig, 10 ref.

Descriptors: Groundwater pollution, Farm wastes, *Infiltration rates, *Farm lagoons, Sewage ponds, *Sealing, Cattle, Dairy Industry.

Infiltration rates of contaminated water from manure ponds are discussed. Infiltration rates of a dairy waste pond were measured with irrigation water before manure water was applied. Infiltration decreased from 48 inches per day with clean water to 0.2 inches per day with manure water after 4 months. (Lee-East Central)

### 1149-A2, A5, B2, F1
MANURE SLURRY IRRIGATION SYSTEM RECEIVING LOT RUNOFF,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
J. I. Sewell.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper no. 72-443, 13 p, 7 fig, 5 ref.

Descriptors: *Pollution abatement, Runoff, Groundwater, *Slurries, Irrigation systems, *Cattle, Farm wastes, Waste disposal, Management, Feed lots.

Plans for facilities and system design for a manure slurry irrigation system are presented. This system consisting of a storage tank, chopper-agitator-pump unit, flush pits, irrigation pipe and a large sprinkle performed durably in testing and offered possibilities for improved efficiency in manure management. It created a minimum of pollution problems. The operational plans and system costs are outlined. (Fomby-East Central)

### 1150-B2, B3, B4, E2, F1
OBSERVATIONS OF DAIRY MANURE HANDLING SYSTEMS,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
D. W. Bates.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No 72-413, 3 p.

Descriptors: *Waste disposal, *Waste storage, *Farm wastes, Waste treatment, Cattle, Dairy industry.
Identifiers: Stall barn, Stacking system, Bedding, Solid alleys, Slatted alleys, Liquid manure systems.

Because of the need to reduce labor in handling manure, the cost of bedding, and regulations dealing with the handling and disposition of animal manure, old manure disposal methods are being replaced by new. Various systems for the daily hauling will depend somewhat on whether the farmer has a stall barn or free-stall barn. Slatted or solid alleys, automatic scrapers, and a new manure pump which forces manure from a collection point in the barn through a pipe to an external manure pit for storage and later removal are discussed. Storage capacity is an important facet for dairymen, particularly in the colder regions of the country. Advantages of figuring construction costs prior to building, and disadvantages of 'adding on' are discussed. (Dudley-East Central)

### 1151-A11, B1
IMPROVED BEEF CONFINEMENT FACILITIES THROUGH PIT VENTILATION AND TEMPERED AIR INTAKES,
Northern States Power Co., Minneapolis, Minn.
M. Nabben.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-449, 7 p.

Descriptors: *Ventilation, *Farm wastes, *Viruses, Animal diseases, Cattle.
Identifiers: Fogging, Velometer test.

The high incidence of virus pneumonia in animals with cough problems in a feeder beef cattle herd prompted the owner and veterinarian to seek the cause and solution. They believed that the ventilation system (which is described in detail) was the main factor causing illness. The air flow patterns in the building were rearranged; exhaust fans were installed to remove gases created in the liquid manure pit; and electric heaters were installed in every fresh air intake to eliminate fogging. Before these changes were made, there was a 10% death loss of cattle and frequent visits were made by the veterinarian. After the changes were made (during the 1971-72 winter), there were no deaths nor veterinarian trips. (Dudley-East Central)

### 1152-A12, B1, B2, D3

**PERFORMANCE OF BEEF ANIMALS AS AFFECTED BY CROWDING AND THERMAL ENVIRONMENT DURING A FALL-WINTER PERIOD,**
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
G. W. A. Mahoney, A. F. Butchbaker, and J. L. Fryrear.
Paper presented at 65th Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No, 72-426, 18 p, 5 fig, 1 tab, 6 ref.

Descriptors: Production, Cattle, Windbreaks, *Oxidation lagoons, *Waste water treatment, *Farm wastes, Productivity, Feeds.
Identifiers: Crowding, Slotted floors, Weight gain.

Results of feed trials made in fall-winter periods of 1969-1972 are reported. The objectives of these trials were: (1) Compare production and feed consumption for 3 levels of crowding, (2) Compare production and feed consumption rates for cattle on slotted floors with wind breaks and shades with cattle in open cattle pens, (3) Determine performance of a cattle waste oxidation ditch for fall-winter operation in the Southwest. Corresponding results were: (1) Maximum gains and feed efficiency were obtained at approximately 20-22 square feet per animal. (2) Weight gain of cattle on slotted floors was not significantly greater than those in open pens, (3) Cold weather freezing indicated that enclosure of oxidation ditches might be necessary for their effective use in the Southwest. (Marquard-East Central)

### 1153-A11, D1, F6

**MATHEMATICAL SIMULATION OF ENERGY METABOLISM IN BEEF ANIMALS,**
Oklahoma State Univ., Stillwater.
M. D. Paine, J. A. Witz, A. F. Butchbaker, C. M. Bacon, and J. E. McCroskey.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-510, 25 p, 8 fig, 2 tab, 26 ref.

Descriptors: *Feed lots, *Mathematical models, *Energy, Systems analysis, Farm wastes, Cattle, *Animal metabolism.
Identifiers: Bioenergetics.

A mathematical model is presented that determines the amount of energy gained and lost in a feedlot situation by using a systems approach. Validation of the complete model indicated that more experience with model parameters will be necessary. However, the model did show potential for making valid estimates of animal growth and feed consumption. Possible applications of the model are demonstrated and discussed. Figures and tables list feedlot variables considered and predictions vs. experimental data in determining the validity of this mathematical model. (Marquard-East Central)

### 1154-A11, B1

**WINTER AND SUMMER SHELTER FOR BEEF CATTLE IN LOUISIANA,**
Louisiana State Univ., Alexandria. Dean Lee Agricultural Center.
J. Pontif, W. A. Nipper, A. F. Loyacano, and H. J. Braud.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No 72-425, 23 p, 6 fig, 7 tab, 6 ref.

Descriptors: *Feed lots, *Farm wastes, *Louisiana, Windbreaks, *Climates, Cattle, Feedlots.
Identifiers: Shelters, Fans.

The purpose was to learn what advantage in feedlot performance of fattening cattle could be attributed to winter shelter and summer shade and fans under Louisiana feedlot conditions. Experimental procedures are detailed. Findings are reported in figures and tables. It was found that (1) winter roofs did not improve gain, (2) windbreaks were detrimental to daily gains because they prevented drying of wet floors, (3) fans did not increase gains, and (4) summer shades were most beneficial in promoting gains. (Marquard-East Central)

### 1155-A11, F6

**THE FATE OF SOLUBLE MUCHIN IN THE GASTRO-INTESTINAL TRACT OF SHEEP,**
Cambridge Univ. (England). Dept. of Veterinary Clinical Studies.
J. F. Hecker.
Journal of Agricultural Science, Vol 80, p 63-69, 1973, 4 tab, 40 ref.

Descriptors: *Nitrogen, *Sheep, Enzymes, Hydrolysis.

Identifiers: *Soluble mucins, *T.C.A.-soluble mucin, Rumen liquor, Caecal liquor, Faecal liquor, Gastro-intestinal tracts, Fucose, Rhamnose, Hexose, Methyl pentose, Histology.

The fate of soluble mucins in the gastro-intestinal tract of sheep was determined. Incubation of a soluble mucin with liquor from large intestinal contents resulted in loss of mucin. Some of this loss was due to soluble enzymes. The loss of mucin was less when incubation was with rumen liquor and varialbe when with ileal liquor. The mean amounts of nitrogen in a soluble mucin fraction which was soluble in trichloroacetic acid (T.C.A.-soluble mucin) were 2.5, 7.3, and 20.0 mg per 100 ml in rumen, caecal and faecal liquors respectively. These amounts were only a small proportion of the total soluble nitrogen in these fluids. Amounts of T.C.A.-soluble mucin, measured by sugar content, were greatest in contents from the small intestine. When the amounts of T.C.A.-soluble mucin were compared with the amounts of lignin in the samples, there was an increase between the abomasum and the first part of the small intestine and than a decrease to the caecu. Amounts relative to lignin were low in other parts of the gastro-intestinal tract. The liquors was in ileal liquor. The presence of the methyl pentoses, fucose and rhamnose indicates that the T.C.A.-soluble mucin is derived from mucus and bacteria. (East-Central)

### 1156-B3, B4, C1, C2

**SEEPAGE LOSSES AND FERTILIZER PRESERVATION IN MANURE STACKING PRACTICE,**
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
T. S. Hsu, C. O. Cramer, and J. C. Converse.
American Society of Agricultural Engineers, Paper No. 72-442, 1972. 23p, 8 tab, 11 fig., 15 ref.

Descriptors: *Seepage, *Farm wastes, Cattle, *Solid wastes, Organic matter, *Nutrients, Nitrogen, Physical properties, Chemical properties, Volatility, Degradation (Decomposition), Dairy, *Waste disposal, *Waste storage, Wisconsin, Biochemical oxygen demand, Chemical oxygen demand.
Identifiers: *Manure stacking, Bedding, Steam distillation method.

A model study of manure stacking using a 3x3 factorial design with two replicates was conducted to determine the effect of type and amount of bedding on seepage losses, manure degradation and volumes. Corn stalks and oat straw were utilized in the experiment at 3 levels: (1) the control (no bedding), (2) the addition of 1.5 lb. of bedding material per 60 lb of fresh manure, and (3) the addition of 3.0 lb. of bedding material per 60 lb. of fresh manure. The following conclusions were reached: the addition of bedding material to fresh manure decreases the losses of organic matter, solids, and nutrients in the seepage from the manure stacks; corn stalks significantly reduce the losses of seepage and nitrogen, COD, BOD, and solids in the seepage while oat straw does not; a high percentage of organic matter, nutrients and solids are preserved in the stacks; and higher quantities of BOD5, COD, solids, and nutrients were lost in the seepage from the stacks with a lower level of treatment before the freezing period and immediately after the spring thaw. Experimental procedures and results are outlined. (Dudley-East Central)

### 1157-B2, B3, D1, D2, D3, E2, F2

**CANADA ANIMAL WASTE MANAGEMENT GUIDE,**
Canada Committee on Agricultural Engineering.
Canada Animal Waste Management Guide, Canada Animal Waste Management Guide Committee under the authority of Canada Committee on Agricultural Engineering, 57 p, 1972, 9 tab., 4 fig., appendices.

Descriptors: *Farm wastes, *Livestock, *Production, *Design, *Management, Pollution, Manure utilization, Nitrogen, Farm lagoons, Aerated lagoons, Aerobic treatment, anaerobic digestion, *Waste storage, *Waste disposal, Dehydration, Incineration, Zoning, Regulations, Legal aspects, Equipment, Fertilizers, Canada.
Identifiers: *Canada legislation, Dead bird disposal, Composting.

Current Canadian practices which provide reasonable approaches to handling animal wastes were compiled with particular emphasis on using the land as a recycling system. Detailed information is given for (1) manure management, (2) utilization of manure in crop production, (3) site selection, zoning and building construction of manure handling systems, and (4) processing of animal wastes. Relevant legislation on animal waste management in each province and addresses of equipment manufacturers are also included. (Dudley - East Central).

### 1158-A2, B2, B3, E2

**DO YOU HAVE TO MOVE 'EM OR CAN YOU LEAVE 'EM,**
Agricultural Research Service, Lincoln, Nebr.
N. Swanson.
Nebraska Farmer, p 13, 15, February 3, 1973, 1 fig.

Descriptors: *Feed lots, Runoff, *Waste storage, *Waste disposal, *Water pollution control, *Irrigation systems, Flood protection, Dikes, Sumps, Basins, Nebraska, Cattle.
Identifiers: SCS Rural Environmental Assistance Program.

By using help from government agencies, it is possible to control runoff from feed lots which previously might have had to relocate. As an example, the Soil Conservation Service and agricultural engineers developed a dike system for a problem feedlot on the banks of a stream. The dike prevents runoff and floods and provides weather protection for the cattle. A basin collects the runoff which is then pumped into a sump and then the water is disposed of by irrigation. The solids are spread across the top and slopes of broad-basin terraces or mounded in the feedlot. (Marquard-East Central)

## 1159-B2, B3, B4, D3, E2

**METHODS OF SWINE MANURE DISPOSAL,**
Illinois Univ., Urbana.
A. J. Muehling.
In: Oregon State University, Corvallis, Agricultural Experiment Station, Special Report 316, p 10-13, December 1970.

Descriptors: *Farm wastes, *Management, *Waste disposal, *Hogs, Lagoons, Irrigation, Waste treatment.
Identifiers: Solid floors with bedding, Slotted floors.

Due to new anti-pollution laws, swine producers are compelled to plan ahead before enlarging or building new facilities for their swine. Guidelines for planning such facilities are accompanied by descriptions of the following manure handling systems: (1) solid floors with bedding - store and haul, (2) slotted floors - store and haul, (3) slotted floors - combination of lagoon and hauling, (4) slotted floors - oxidation ditch-lagoon, (5) flushing gutter-lagoon-irrigation. (Dudley-East Central)

## 1160-A2, C1, C2, F6

**CHARACTERISTICS OF CATTLE FEEDLOT SURFACE RUNOFF,**
J. C. Ward, E. M. Jex, and T. E. Norton.
Typescript, (1970), 4 p, 1 tab.

Descriptors: *Feed lots, *Surface runoff, Dissolved solids, Biochemical oxygen demand, *Cattle, Conductivity, Hydrogen ion concentration, Water pollution sources.
Identifiers: Volatile solids, Van't Hoff-Arrhenius relationship, Onsager equation.

This study has two parts: (1) the complete mixing of cattle manure with distilled water to obtain characteristics of the manure, and (2) examination of surface runoff samples from cattle feedlots in order to ascertain their characteristics as a function of several hydrologic variables. In part 1, the supernatant from samples was examined for conductivity, pH, dissolved solids, volatile solids, and BOD. In part 2, a simulated rainfall apparatus was utilized to obtain runoff samples. These samples were analyzed on the spot and in the laboratory for ultimate BOD, conductivity, alkalinity, settleable suspended solids, volatile solids, and dissolved solids. (Dudley-East Central)

## 1161-A11, B2

**COMMON MISUNDERSTANDINGS ABOUT HEATED DISCHARGES,**
Federal Water Pollution Control Administration, Southeast Region, Atlanta, Ga.
C. B. Wurtz.
In CLEAN WATER FOR THE NATION'S ESTUARIES, Transcript of Public Meeting, Biloxi, Mississippi, January 17, 1968, p 4.

Descriptors: *Hydroelectric plants, *Heated water, *Ecology, *Aquatic animals, *Thermal pollution, Predation, Pathogenic bacteria, Physiological ecology, Animal metabolism, Animal parasites, Water quality, Bacteria, Electric powerplants, Engineering structures, Industrial plants, Structures, Powerplants, Afterbays, Spawning, Wildlife, Dissolved oxygen, Fish, Animals, Aquatic life, Food chains, Water types, Fisheries, Public health, Microorganisms, Plants.

The author describes five common misunderstnadings about the effects of heated discharges on aquatic life. These misunderstandings relate to the belief that an increase in water temperature will: (1) Cause a reduction in the capacity of the water to retain dissolved oxygen. (2) Cause a deterioration in the 'quality' of the biological community, i.e., less desirable species of organisms will replace more desirable species. This is usually argued as an increase of only two or three degrees without any scale being mentioned. (3) Cause fish to spawn earlier, and at a time when suitable food organisms for survival of the young stages will not be present. (4) Change metabolic rates to the extent that individual organisms will be living under conditions of physiological stress, and thus be vulnerable to adverse conditions they may have otherwise resisted. (5) Cause an increase in the numbers of predators, parasites, and/or pathogens, and thus cause significant deterioration of a fisheries resource or create a public health hazard.

## 1162-A8, C2, E2

**PERSISTENCE OF MANURE PHOSPHORUS AVAILABILITY IN CALCAREOUS SOIL,**
Arizona Univ., Tuscon. Dept. of Soils, Water and Engineering.
J. L. Abbott, and T. C. Tucker.
Soil Science Society of America Proceedings, Vol 37, No 1, p 60-63, January-February, 1973. 1 fig, 5 tab, 11 ref.

Descriptors: *Fertility, *Waste disposal, *Phosphorus, Nitrogen, *Calcareous soils, Cotton, Barley, Alfalfa, Arizona, Cycling nutrients.
Identifiers: *Plant nutrition, Pollution control.

The contribution of P from manure to Calcareous soils was studied on a Mohave clay loam. Manure treatments involved different amounts and frequency of manure application, and were split with nitrogen variables of 0, 84, and 168 kg/ha. Total P content of manures ranged from 3-5 kg per metric ton during the course of study. The results indicated that manure is an effective source of P as illustrated by the increased P content of cotton, barley, and alfalfa tissue as well as soil analysis. Manuring at 2 or 3 year intervals at 22 metric tons/ha assures adequate P availability, while P availability from phosphate fertilizers may be negligible over the same period. (Marquard-East Central)

## 1163-B3, C2, D3, E3

**ACTIVATED SLUDGE AS A SOURCE OF PROTEIN,**
Iowa State Univ., Ames. Dept. of Chemical Engineering.
A. S. Al-Zakri, and A. L. Frey.
Paper No. 72-581, presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, 18 p, 3 tab., 19 ref.

Descriptors: *Activated sludge, Bacteria, *Proteins, Amino acids, Nitrogen, Iowa, *Sewage treatment, Freezethaw tests, *Extraction, E. coli, Recycling, *Waste treatment.
Identifiers: Bacillus megaterium, Biuret reaction.

Activated sludge from a municipal sewage treatment plant was extremely high in protein content. A clear solution obtained from settled activated sludge was frozen and then dried in an oven to yield a solid containing by weight 16.25% nitrogen. A purified protein form was derived through a complicated extracting process. This protein compared favorably with whole cow's milk in animo acid contents. Extraction methods involved are expensive, but another technique, treatment for bacterial breakdown as required with recycling to animals, is promising. (Frantz-East Central)

## 1164-A11, A12, C3

**SALMONELLA IN THE LAYING HEN. I. SALMONELLA RECOVERY FROM VISCERA, FECES AND EGGS FOLLOWING ORAL INOCULATION,**
Louisiana State Univ., Baton Rouge. Dept. of Poultry Science.
N. A. Cox, B. H. Davis, A. B. Watts, and A. R. Colmer.
Poultry Science, Vol 52, No 2, p 661-666, March, 1973, 3 tab, 21 ref.

Descriptors: *Salmonella, *Farm wastes, *Poultry, Bacteria, Diseases, Analysis, Tissues, *Contamination, Eggs.
Identifiers: Inoculation, Seftenberg, Thompson, Typhimurium.

A study was made to determine the fate of Salmonella organisms after ingestion by the laying hen. Three species of Salmonella were used, i.e., senftenberg, thompson and typhimurium. Approximately one million cells of each species were introduced into the crop of 12 White Leghorn type laying hens for 10 days. The trials involving each species were carried out consecutively with thorough disinfection of equipment between trials. From each hen, feces and eggs were analyzed daily for Salmonella for the 10 day period. At the end of the 10 day trial a sample of blood was drawn from each hen for Salmonella analysis. In addition, the hens were slaughtered and a sample of the ovaries, kidneys, heart, liver and lungs was aseptically removed for analysis. Approximately 25% of the fecal samples contained the species of Salmonella under study. The percentage of positive recoveries from egg shells was less than 10% for all three species studied. Among the egg contents examined for all three species, only one egg yielded a positive recovery. All tissue samples were negative. It was concluded that there was no contamination of body tissues even after continuous ingestion of large doses of Salmonella organisms. Neither was there a problem of egg meat contamination among intact eggs. (East Central)

## 1165-A9, A10, A11, B1

**FLY CONTROL AND CHRONIC TOXICITY FROM FEEDING DURSBAN (0,0-DIETHYL 0-3, 5, 6-TRICHLORO-2-PYRIDYL PHOSPHOROTHIOATE) TO LAYING HENS,**
Hawaii Univ., Honolulu. Coll. of Tropical Agriculture.
M. Sherman, and R. B. Herrick.
Poultry Science, Vol 52, No 2, p 741-747, March, 1973, 3 tab, 3 fig, 12 ref.

Descriptors: *Pesticide toxicity, *Farm wastes, *Poultry, Larvae, Feeds, Additives.
Identifiers: Dursban, *Fly control.

The effects of administering technical Dursban at concentration of 25, 50, and 200 ppm in the feed of laying hens were studied over a 52 week period. The estimated mean daily intake of Dursban was 2.48, 5.12, and 20.44 mg. per hen for those receiving 25, 50, and 200 ppm, respectively. Dursban at 50 ppm resulted in excellent control of larvae of Musca domestica L., Fannia pusio (Wiedemann), Chrysomya megacephala (F.), and Boettcherisca peregrina (Robineau-Desvoidy) but only moderate control of Parasarcophaga argyrostoma (Robineau-Desvoidy). No hen mortality occurred that could be attributed to the insecticidal treatment. There was a direct relationship between Dursban concentration and blood plasma cholinesterase inhibition. However, overall feed consumption, body weight, egg production, feed efficiency, egg weight, interior egg quality, and shell thickness were normal. Eggs from treated hens had no detectable off-flavors or off-odors. (East Central)

### 1166-A5, A8, C2, E2, F2

**HOW MUCH MANURE PER ACRE.**
E. D. Anderson.
The Farm Quarterly, Vol 27, No 5, p 44-45, Fall, 1972, 2 tab.

Descriptors: *Farm wastes, *Waste disposal, Hogs, Cattle, *Cycling nutrients, *Fertilizers, Groundwater pollution, *Legal aspects, Nitrates, Productivity, Potassium, Phosphorus, Regulation, Toxicity.

The laws of many states reflect concern over the harmful effects of manure on soil and water. Specific regulations for Kansas, Missouri, and Indiana are discussed. Concern is also reflected in university studies. One study was conducted at Michigan State University to determine a feasible rate of manure application. Manure applications at rates of 10, 20, and 30 tons per acre were made annually from 1963 to 1971 to Conover-Hodunk loam and Metea sandy loam. Soil samples were taken, corn yields were recorded, and mineral analyses of the corn were made. The optimum rate for applying manure to sandy loam was 10 tons per acre. Higher rates posed the hazard of nitrate contamination of ground water and buildup of available nitrogen and potassium. (Dudley-East Central)

### 1167-B1, F4

**AGRICULTURAL WASTES--A MANAGEMENT PROBLEM,**
Ohio State Univ., Columbus.
E. P. Taiganides.
In: Frontiers in Conservation, Proceedings, 24th Annual Meeting, Soil Conservation Society of America, Colorado State University, Fort Collins, August 10-13, 1969, p 90-92, (1969) 2 fig.

Descriptors: *Farm wastes, *Pollution, *Waste disposal, Subsidy, Chemicals, Confinement pens, *Municipal wastes, *Management.
Identifiers: Urban-rural interface.

Our nation's fundamental problems are poverty, pollution, population, and politics. It is necessary to have integrated and coordinated management of resources at the urban-rural interface to prevent environmental pollution. Although particular attention is given to waste management from animal confinement units, all production systems create waste. Regardless of the source-urban or rural- all of these wastes are either organic or inorganic and either solid or liquid. The wastes from all rural and urban areas must be considered as a regional problem whose solution will need the cooperation of the agricultural, industrial, urban, and other political sectors of the nation. A need exists to demonstrate the benefits of cooperation between the rural and urban sectors with an integrated regional scheme of using agricultural soils and nonproductive rural land for waste disposal. (Dudley-East Central)

### 1168-A2, A5, B2, B4, E2

**CALIFORNIA WASTE PONDS ARE PASSING THE TEST,**
M. L. Elam.
Hoard's Dairyman, Vol 118, No 5, p 311, 362, March 10, 1973, 3 fig.

Descriptors: *Irrigation storage ponds, Leaching, Effluent, Nitrates, Salts, Leakage, Pump, Recycling, Dairy industry, *California, *Waste water (Irrigation), Fertilizers, *Farm wastes.

Three California researchers have supported waste ponds as safe and legal means by which dairymen may eliminate waste drainage problems. It is doubtful if the use of waste ponds harms other water supplies. They have little odor and insect production. may be minimized. In a wide variety of soils tested, seepage and transfer of nitrogen and salts into soil were not problems. Farm wastes were easily applied to adjacent cropland. The researchers recommended the use of fifty gallons of water per cow each day and the partial emptying of waste ponds every four to six months. (Frantz-East Central)

### 1169-A4, A5, A8, C2, E2

**CROP YIELDS FROM LAND RECEIVING LARGE MANURE APPLICATIONS,**
Texas A & M University, College Station, Texas, and Texas Agricultural Experiment Station, El Paso, Texas, and Texas Agricultural Experiment Station, Pecos, Texas, respectively.
D. L. Reddell, P. J. Lyerly, and J. J. Hefner, Presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, 14 p., Paper No. 72-960, 7 tab,, 2 fig., 9 ref.

Descriptors: *Application methods, *Cultivation, *Crop yield, Nitrates, Forage, Salinity, *Farm wastes, Cattle, *Waste disposal, Texas, Ground water, Irrigation, Aquifer, *Fertilizers, Moisture content, Nutrients.

The objectives were to evaluate the pollution and crop growth due to deep plowing large amounts of beef manure. Two problems faced by feed lot operators have been finding sufficient land on which to use large quantities of feed lot waste and contending with the excessive salinity of such waste. Three locations with Hoban silty clay loam, and Vinton fine sandy loam were used and graduated amounts of waste up to 900 tons per acre were applied at depths of 14 to 36 inches. Rates of application and nitrate contents of crops yielded are recorded. Results of the study show peak yield and nitrate composition of crops to be on those acres with 25 and 50 tons of farm waste. However, in all locations researchers found that acres with 900 tons per acre yielded more than the check plot (0 tons per acre) and that those most heavily laden plots presented no major surface water pollution problem. (Frantz - East Central).

### 1170-A5, A8, B2, C2, E2

**POLLUTION LOADS IN PERCOLATE WATER FROM SURFACE SPREAD SWINE WASTES,**
Maryland Univ., College Park. Dept. of Agricultural Engineering.
H. L. Brodie. Water Resources Research Center, University of Maryland, College Park, Technical Report No. 13, October 1972. 25 p, 1 fig, 6 tab, 21 ref. OWRR A-019-MO (1).

Descriptors: *Groundwater pollution, *Farm wastes, *Hogs, *Percolation, *Flood irrigation, *Waste disposal, Nitrogen, Chemical oxygen demand, Phosphates, Chlorides, Sulfates, Maryland.

The effectiveness of the soil as a receptor for the concentrations of nutrients and organics in periodic high rate flood applications of liquid swine wastes was investigated. A lysimeter was used for collecting soil percolate waters after flood application of liquid waste or tap water and after rainfall in order to test the soil as a high-rate physical and biological filter for liquid swine wastes. Samples of the saturated flow were removed at depths of 25, 50, and 75 centimeters in the profile and tested for concentrations of chemical oxygen demand, ammonium nitrogen, chloride, total phosphate, and sulfate. The concentrations were compared with the concentrations of the applied liquid to determine net decrease of concentration through the soil profile. Results indicated that flood irrigation can lead to groundwater pollution. (Marquard-East Central)

### 1171-D2, E3

**MONFORT LOOKS AT TREATED MANURE FOR TILE AND PLASTIC.**
Calf News, Vol 10, No 8, p 4, August, 1972.

Descriptors: Feed lots, Plastics, *Tiles, Insulation, *Farm wastes, *Recycling, Waste disposal, *Waste treatment, *Ohio.
Identifiers: *Pyrolysis, Building materials.

Because future laws may restrict land application of feedlot manure, one feedlot has decided to use its wastes in a pyrolysis process to manufacture tile. While this will be the first commercial field test, laboratory results show that the product is superior to conventional tile. By using different proportions of manure and ground glass most building materials or insulation can be made (Marquard-East Central)

### 1172-B2, C2, D3, E3

**OXIDATION DITCH IS CATTLE FEED SOURCE.**
Beef, Vol 8, No 2, p 24, October, 1971.

Descriptors: Oxidation lagoons, *Feeds, *Effluent, Cattle, Aerobic bacteria, Proteins, *Waste treatment, *Recycling, Iowa.

Effluent from an oxidation ditch was used as a feed source. A feed acceptance test found that animals on the effluent ration consumed significantly more feed. The United States Department of Agriculture and the Food and Drug Administration found the carcasses acceptable but warned that further tests must be run before commercial operators can use the effluent as a feed source. One limiting factor has been the protein level: regular feed rations contain under 20% protein while this effluent contains 46.8% protein. (Marquard-East Central)

### 1173-A6, B2, B3, B5, C2, D2

**NEW ODOR CONTROL PROJECT.**
Calf News, Vol 10, No 7, p 22, July, 1972.

Descriptors: *Odor, Waste disposal, *Feed lots, *Lagoons, Oxygen, Nitrogen, Phosphorus, Potassium, Ash, Cattle, *Farm wastes, *Air pollution, *Waste treatment, *Oklahoma.

A new product to control odor and reduce manure volume from feedlots is now being produced by RAD Limited, Inc., of Yale, Oklahoma. The product works on dead organic matter only; and in treated lagoons, no odor gases are produced. On the feedlots, dry solids are decomposed to nitrogen, phosphorus, potassium, and ash. Further tests will determine the proper amounts to be used to prevent a cracking problem which is now encountered in the lagoons. (Marquard-East Central)

### 1174-B2, D1, E2, F1

**LIQUID WASTE SEEPS FROM ONE BASIN TO ANOTHER.**
Feedlot Management, Vol 13, No 6, p 56-57, June, 1971.

Descriptors: Aquifer, Cattle, *Farm wastes, Feed lots, Fertilizers, Irrigation systems, *Settling basins, *Lagoons, *Waste treatment, *Waste disposal, *Water pollution control, Nebraska.

In the waste handling system manure solids and liquids go into a 'debris basin' where solids settle to the bottom. The liquid passes through a rock-filled retaining wall, seeps through a median strip to the 'blackwater basin,' and is pumped back up hill onto land. It is then channeled through irrigation outlets to surrounding croplands where it seeps into the ground, gives up its plant food nutrients, goes to an underground aquifer, and eventually deposits pollution-free water into the Missouri River. Total cost of the feedlot, including the $400 per acre cost of the pollution control system (built with farm labor and equipment most farmers have available) amounted to $27,000-$27 per animal. (Hisle-East Central)

### 1175-A2,A4,A5,A6,A10,F2

**ANIMAL WASTE DISPOSAL,**
Montana State Dept. of Health, Helena. Div. of Environmental Sanitation.
C. W. Brinck.
*In*: Montana Agriculture - Focus on Improving the Environment, (Proceedings), College of Great Falls, December 3-4, 1970, p 41-43. (1970).

Descriptors: *Water law, *Regulation, *Permits, *Feed lots, Waste disposal, Waste treatment, Water pollution control, Cattle, *Montana.

Montana water pollution laws are traced from 1907 through the 1970 regulation attempt to require feedlot location permits by 1973. Permits are to be issued on the basis of proximity of the feedlot to its neighbors, the possibility of odors being carried toward urban areas, fly problems, prevention of drainage to streams, the pollution of underground water and the potential for good feedlot maintenance. Permits will be required for all new construction. For existing feedlots, it is proposed that a permit be required for any feedlot located closer than one mile to the boundary of an incorporated city or town within one year after passage of the regulation. (Hisle-East Central)

### 1176-A5, A8, B1, C2, E2

**ANIMAL WASTE DISPOSAL,**
Connecticut Agricultural Experiment Station. New Haven Dept. of Soil and Water.
C. R. Frink.
Compost Science, p 14-15, November-December. 7 ref.

Descriptors: *Farm wastes, *Waste disposal, Water pollution, Nitrates, Nutrients, Sewage treatment, *Fertilizers, *Farm practices.

Recent data show that manure applied to field crops does not improve yields enough to offset the cost of hauling and spreading. Alternatives are (1) stop producing manure, (2) hide it on the 'back forty,' or (3) place it in a sewage treatment plant. These are not acceptable because we need the food produced by the animals, 'hiding it' may contaminate drinking water, and sewage treatment is too expensive. With alternative methods exhausted, the data must be re-examined for application of manure to field crops. Studies indicate that improved agronomic practices will increase the efficiency of nitrogen utilization and reduce the total nitrogen imparted on the farm. It is also suggested that, when feasible, animal wastes be applied to forest lands. (Marquard-East Central).

### 1177-A2,A8,B2,B3,C2,E2

**DISPOSAL OF BEEF FEEDLOT WASTES ONTO CROPLAND,**
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
H. L. Manges, L. S. Murphy, and E. H. Goering.
Paper No. 72-961, presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, 12 p, 5 fig, 1 tab, 6 ref.

Descriptors: *Farm wastes, *Waste disposal, Cattle, *Feed lots, Runoff, *Rates of application, *Irrigation, Corn (Field), Soil properties, Nitrogen, Phosphorus, Potassium, Sodium, Salinity.
Identifiers: Greensberg silty clay loam, Plant population, Forage yields.

A series of field plots were established to determine the influence of waste loading rates on corn forage yield and on soil properties. Separate field plots of Greensberg silty clay loam soil were established for disposal of runoff and manure. Runoff was applied to the land during the irrigation season; manure was spread after corn harvest and plowed under to a depth of 12 inches. Corn was surface planted on these plots with no pre-irrigation. Herbicides were used to control weeds, and irrigation water (from a well) supplemented runoff treatments and provided adequate moisture for the manure plots. The plants were counted to evaluate effects of treatments on population; the forage was weighed when ready for ensiling; and soil samples were taken at a depth of 10 feet, with additional samples at 3 feet in the manure plots, prior to corn planting, to assess decomposition of the manure. Conclusions were that corn plant population decreases linerily with increasing accumulated feedlot waste loadings; annual application of 10 inches of feedlot runoff gave maximum corn forage yields; and land disposal of feedlot wastes can lead to saline soil conditions and high nitrate-nitrogen concentrations in the soil profile. (Hisle-East Central)

### 1178-A6,A7,A11,A12,B2, B4,D3

**ODOR CONTROL MAY BE A BIG CONCERN,**
Wisconsin Univ., Madison.
J. C. Converse.
Hoard's Dairyman, Vol 118, No 13, p 819, July 10, 1973.
U.S. Patent No 3,744,637, 5 p, 2 fig, 7 ref; Official Gazette of the United States Patent Office, Vol 912, No 2, p 550, July 10, 1973.

Descriptors: *Patents, Equipment, *Aeration, Separation techniques, *Waste water treatment, Water pollution control, Pollution abatement, Water quality control, *Baffles.
Identifiers: Clarification.

A waste treatment tank has a baffle dividing it into an aeration and a clarification section. Air flow is introduced into the tank at the bottom of the baffle in the aeration section and at the top of the baffle in the clarification section. Aeration section air flow creates a circulatory mixture flow upward along the lower wall surface of the baffle. Air introduced into the clarification section skims sewage solids from that section and forces solids into the aeration tank section. (Sinha-OEIS)

### 1179-A2,B2,B4,D1,E2,F1

**THE PRICE TAG TO STOP FEEDLOT RUN-OFF,**

Beef, Vol 8, No 8, p 6-7, April, 1972, 4 tab.

Descriptors: *Farm wastes, *Waste disposal, *Feed lots, Settling basins, Lagoons, Irrigation, Nutrients, Runoff, Diversion structures, Terraces (Agricultural), Missouri, *Installation costs, *Operating costs, Cattle.

A Missouri engineer calculates the cost of a system to prevent feedlot run-off at $1,000 to $3,500 plus $300 to $600 yearly operation costs. His system consists of a diversion terrace to catch run-off, a settling basin to eliminate most solid waste in run-off, and a lagoon to hold run-off water. Irrigation equipment to pump run-off to adjacent farmland is included in the cost. Pumping rates vary and liquid may be distributed by gated pipe, hand carried sprinklers, or traveling Big Gun systems. The lagoon, ranging from 110,000 cubic feet upward, requires an earthen dam. Costs on all aspects of the system have been itemized in tables according to capacity lot sized from 200 to 1,200 head. (Frantz-East Central)

### 1180-A2,A5,A8,B2,B4,D3,E2 F1

**CATTLE FEEDLOT POLLUTION STUDY,**
Texas Tech Univ., Lubbock. Water Resources Center.
D. M. Wells, E. A. Coleman, W. Grub, R. C. Albin, and G. F. Meenaghan.
Interim Report No. 1 to Texas Water Quality Board, November, 1969. 34 p, 6 fig, 11 tab.

Descriptors: *Cattle, *Feed lots, *Farm wastes *Waste disposal, *Waste treatment, Runoff, Precipitation, Water pollution, Irrigation, Percolation, Waste storage, Ponds, Management, Biochemical oxygen demand, Nitrogen, Aerobic treatment, Anaerobic digestion, Field crops, Germination, Texas, Cattle.
Identifiers: Flushing.

Alternative feedlot management and waste disposal systems were evaluated and agronomic studies were conducted for the economic utilization or treatment of feedlot wastes. Both dirt and concrete-surfaced feedlots were used in a conventional manner. It was tentatively concluded that conventional aerobic treatment processes are not economically feasible solutions to the problem of treatment and disposal of cattle feedlot runoff resulting from natural precipitation; that runoff from feedlots operated in a conventional manner is not suitable for direct application as irrigation on most field crops; that anaerobic treatment processes offer the best hope for treatment of feedlot runoff; and that storage of feedlot runoff in unlined ponds and treatment and disposal of feedlot runoff on agricultural lands may pose a hazard to groundwater pollution. Recommendations were that further study be given to the possibility of changing feedlot practices to provide for daily flushing and treatment by conventional means; that the agronomic studies be continued to determine safe rates of application and safe dilution factors for selected crops; and that the infiltration studies be continued and expanded to include the analyses of cores taken in the vicinity of storage ponds and the construction and operation

### 1181-A4, B2, E3

**SALMON THAT NEED NEVER SEE THE SEA,**
Rhode Island Univ., Kingston.
T. L. Meade.
The American Fish Farmer, Vol 4, No 5, p 9-10, April, 1973, 3 fig.

Descriptors: *Recirculated water, *Salmon, Rhode Island.
Identifiers: *Controlled environment, *Toxic wastes, Denitrification column.

A system capable of raising salmon in a controlled environment was developed. Salmon were cultured in this controlled environment from incubation of eggs through the grow-out phase. This facility is outdoors and consists of four insulated silo-like tanks, 5 feet in diameter and 12 feet high. These tanks provide two separate culture units, each consisting of two tanks and associated biological filters, pumps, refrigeration, heating, and oxygen units. The system is essentially closed with continuous reuse of the water until the buildup of nitrate nears an unacceptable level. The results of these studies have seen incorporated in the design of a denitrification column which, when placed in operation, should eliminate the need to discharge water from the system. (Hisle-East Central)

### 1182-C2, C3, D2, E3

**BACTERIOLOGICAL PROCEDURES FOR ANALYZING WET AND DRIED POULTRY FECES,**
Michigan State Univ., East Lansing. Dept. of Poultry Science.
H. C. Zindel, T. S. Chang, and G. R. Carter.
Journal Article No. 5928, Michigan Agricultural Experiment Station, College of Agriculture and Natural Resources, Michigan State University, East Lansing, 1972, 4 p, 2 ref.

Descriptors: *Farm wastes, *Dehydration, *Poultry, *Bacteria, *Chemical analysis, Recycling, Incubation, Michigan.

The accurate analysis of feces, both wet and dry, for chemical and bacteriological content is important since animal feces is a raw product which has great potential if properly gathered, processed and utilized. When Michigan State University began a dehydration process several years ago, it obtained bacteria count and identification as well as chemical analysis for both wet and dry fecal samples. The bacteria present in the feces after the drying process were identified and recorded. Some bacteria were present after the drying process, but they were not thought to be significant because most of them were normal flora in the intestinal tract of chickens and some of them are commonly known contaminants. Their presence either suggested that the retention time of the feces in the dryer was not long enough to destroy all bacterial populations or that they were recontaminated while leaving the drying unit. (Hisle-East Central)

### 1183-A8, B2, B3, E2

**CONFINEMENT. IN ARIZONA.**

Calf News, Vol 11, No 3, p 52-53, 68-69, March, 1973.

Descriptors: *Farm management, *Farm wastes, *Confinement pens, *Feed lots, *Cattle, Effluent, Waste disposal, Irrigation system, Fertilizers, Alfalfa, Arizona.

Arlington Cattle Company decided to expand their Arizona feedlot operations through confinement housing in order to make manure management easier. The following advantages were listed for confinement housing: (1) more economical, (2) easier to handle animals, (3) better working conditions, (4) better management of mud, dust, odor, and flies, (5) a savings in manure handling of about $13,000 yearly. The manure system for the new facility will be scrapers running lenghwise under the slotted floor barns. Gravity will take the effluent to a pumping station which will move it to cropland where it merges with the flood irrigation system. Alfalfa will be grown on this property owned or controlled by Arlington Cattle Company. (Dudley-East Central)

### 1184-A4, A5, A7, B1, D1, D2, E2, E3, F5

**ANIMAL WASTE MANAGEMENT IN HAWAII,**
Hawaii Univ., Honolulu. Dept. of Civil Engineering.
G. L. Dugan, R. H. F. Young, and G. Takamiya.
Journal Water Pollution Control Federation, Vol 45, No 4, p 742-750, April, 1973, 1 fig., 4 tab., 22 ref.

Descriptors: *Farm wastes, *Livestock, *Waste disposal, *Waste treatment, Air pollution, Water pollution, Goundwater pollution, Waste water treatment, Biochemical oxygen demand, Nitrogen, Ponds, Drying, Incineration, Recycling, *Hawaii.
Identifiers: Subtropical environment, Land spreading, Composting.

The unavailability of land suitable for accepting animal excrement near large animal raising facilities is a very critical problem in Hawaii. The problem is intensified by the pollution potential caused by the close proximity of land to the ocean. Various methods of managing animal waste ranging from land spreading to drying and incineration are discussed. A waste handling system that seems to be adaptable to a subtropical environment is a hydraulic recycling system incorporating photsynthetic reclamation. The process is based on hydraulic handling of animal excrement; gravity liquid-solids separation; aerobic biological treatment in which oxygenation can be accomplished either by the photosynthetic activity of algae or by mechanical aeration; anaerobic biological treatment; and harvesting algae from the aerobic phase, which provides the potential for nutrient recovery in the form of a high-protein animal feed supplement. (Dudley-East Central)

### 1185-A2, A3, A4, A5, A9, B1, F1, F4

**ECONOMICS OF WATER POLLUTION CONTROL,**
Economic Research Service, Washington, D.C.
J. P. Biniek.
In: Frontiers in Conservation, Proceedings, 24th Annual Meeting, Soil Conservation Society of America, Colorado State University, Fort Collins, August 10-13, 1969, p 102-106 (1969) 1 tab., 10 ref.

Descriptors: *Pollution, *Water pollution, *Economics, Herbicides, *Water pollution control, Animal wastes, Waste disposal, Livestock, Feed lots, Runoff, Waste treatment, Percolation, *Management.

In broad, general terms many problems in the economic area of pollution control are discussed. Pollution is defined as 'the unfavorable alteration of our surroundings, wholly or largely as a byproduct of man's action.' Many means of ridding ourselves of pollutants often result in further pollution. The difficulty of securing a balance between production needs and the externalities of economics (the beneficial) and diseconomies (the harmful) is discussed along with the costs of pollution control, the economics of agricultural pollution and the role of economics as a whole. (Dudley-East Central)

### 1186-A4, B2, B3, B4, C2, D2, E1, E2, F1, F2

**TECHNICAL AND LEGAL CONTROLS FOR THE DISPOSAL OF ANIMAL WASTES,**
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
Raymond C. Loehr.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 507-519. 2 fig, 5 tab, 21 ref.

Descriptors: *Animal wastes, *Runoff, *Management, *Farm management, *Aerobic treatment, *Water pollution, *Water pollution control, *Water pollution treatment, *Solid wastes, *Legal aspects, Runoff forecasting, Cattle, Hogs, Poultry, Farm wastes.
Identifiers: *Manure, *Agricultural runoff, Anaerobic lagoons.

Several alternatives exist for disposal of animal wastes: (1) land disposal of liquids and solids, (2) solids combustion with land disposal of liquid, and (3) discharge of solids and liquids to receiving waters. All these alternatives are potential sources of water pollution. The quality of treated and untreated animal waste waters, both from a legal point of view and a farmers point of view, are discussed. Animal wastes are normally semi-solid, thus high in BOD, COD, suspended solids, Na, NH3. If rainfall runoff is allowed to mix with the animal wastes, a larger volume of waste will need to be treated. Many states now consider large livestock operations to be industrial processes and require treatment of wastes in such a manner that receiving waters are not harmed by discharge of animal waste waters. Waste water runoff holding ponds are commonly used with intermittent discharge to receiving waters or land disposal. Several processes are used for treatment of animal wastes, the more common being anaerobic lagoons, aerobic lagoons, aerated lagoons, oxidation ditches, or a combination of anaerobic-aerobic treatment. In more arid areas, runoff holding ponds are sometimes satisfactory. Handling and treating animal wastes as a liquid usually involves less labor, less expense, and thus is more commonly found in large livestock operations where concrete pens are found and confinement is practiced. Since liquid wastes require more treatment, handling the animal wastes directly as a semi-solid with land disposal might be a more economic method. (Makela-Texas)

### 1187-B2, B3, C2, D3, E3, F5

**THE MANAGEMENT AND DISPOSAL OF DAIRY MANURE,**
Washington State Univ., Pullman. Coll. of Engineering.
Donald E. Proctor.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 554-566, 8 fig.

Descriptors: *Animal wastes, Management, *Farm management, *Dairy industry, *Algae, *Cattle, Slurries, Spraying, Activated sludge, Farm wastes.
Identifiers: *Manure, Anaerobic lagoon, Aerated lagoon.

Dairy manure can be either an asset or a liability depending on the farmer's management policies. Increased demand for livestock-derived products, specialization of farm operations, confinement rearing, cheaper chemical fertilizers, urban sprawl and farm area encroachment, and higher aesthetic standards are all facets of the changing problem of manure disposal. Of these changes, confinement rearing is most significant. Not only is the manure concentrated into a smaller area, but rainfall runoff can treble the waste volume to be handled. Two Washington State dairy farms received Federal Demonstration Project Grants, the Knott Dairy Farm of the Washington State University receiving a grant from the FWPCA, and the Monroe Honor Farm of the State of Washington Institutional Farm Industries receiving a grant from the Public Health Service. The two-year project at the Knott Dairy Farm proposed to (1) demonstrate the capabilities of an anaerobic lagoon for first stage treatment of dairy manure, (2) demonstrate the comparative capabilities and economics of activated sludge and naturally aerated lagoons for second stage treatment and (3) determine whether it is possible and practical to reduce the nitrogen and phosphorus content of the treated effluent by algae propagation and harvesting for use as cattle feed. The Monroe Honor Farm project proposed to (1) demonstrate the capabilities of an anaerobic lagoon for first stage treatment of dairy manure. (Makela-Texas)

### 1188-A6, A7

**IDENTIFICATION OF BEEF CATTLE FEEDLOT ODORS,**
Texas Tech Univ., Lubbock. Dept. of Chemical Engineering.
R. M. Bethea, and R. S. Narayan.
Transactions of the ASAE, American Society of Agricultural Engineers, p 1135-1137, 1972, 2 fig., 2 tab., 10 ref. (Order No. T 1135).

Descriptors: *Air pollution, *Odor, *Cattle, *Feed lots, *Farm wastes, *Gases, Gas chromatography, Solubility, Alcohols.
Identifiers: Amines, Aldehydes, Esters, Carbonyls.

The qualitative nature of the gases present in the atmosphere around a beef cattle feedlot was studied. The selective solubility method was adopted for identification of volatile organic compounds caused by cow manure. Gas chromatographic analysis extended the findings of the solubility tests. A feedlot chamber was set up for a 550 pound steer in order to obtain information about compounds present in the atmosphere of enclosed feedlots. The chamber was managed three ways. One week it was thoroughly cleaned and washed each day. The next week it was shoveled out, but not washed. The third week it was not cleaned at all. During the first phase, only a few odoriferous contaminants were generated. When daily washings were discontinued, indole and skatole were detected in the chamber atmosphere. The number of compounds present in this atmosphere increased threefold during the last phase. It is inferred that chamber management has tremendous influence on the organic compounds present in the atmosphere of an enclosed feedlot. (Hisle-East Central)

### 1189-C2, E2, F1

**A FEEDER LOOKS AT ANIMAL WASTE DISPOSAL,**
Miller Feed Lot, Shepherd, Mont.
A. L. Miller.
In: Montana Agriculture - Focus on Improving the Environment, (Proceedings), College of Great Falls, December 3-4, 1970, p 44-46. (1970).

Descriptors: *Farm wastes, *Waste disposal, *Feed lots, *Fertilizers, Cattle, Nitrogen, Phosphorus, Silage, Missouri, Montana.

January 1, 1970, figures are given for the number and size of the nation's feedlots. The possibility of using animal wastes as a fertilizer is emphasized. The Miller Feed Lot analyzed its animal waste to see if it would be profitable as a fertilizer. Its value from the nitrogen phosphorus alone was about $1.00 to $3.00 per ton, so the company decided to sell the fertilizer to the farmers at not over 50 cents per ton. In order to do this quickly, a five yard capacity front-end wheel loader was used to stack the fetilizer in expanded pens and to load it on the farmers' trucks. (Hisle-East Central)

### 1190-B5, C2

**NUTRITIONAL INTERRELATIONSHIPS OF DIETARY CALCIUM, PHOSPHORUS, AND MAGNESIUM IN SHEEP,**
Florida Univ., Gainesville. Dept. of Animal Science.
C. F. Chicco, C. B. Ammerman, J. P. Feaster, and B. G. Dunavant.
Journal of Animal Science, Vol 36, No 5, p 986-993, May 1973, 1 fig, 6 tab, 28 ref.

Descriptors: *Calcium, *Phorphorus, *Magnesium, *Sheep, Metabolism.
Identifiers: *Nutritional interrelationships, Plasma, Fecal excretion, Basal diet, Femur deposition.

Four experiments were conducted with 116 wethers to study dietary interrelationships of calcium, phosphorus and magnesium. Including all experiments dietary levels varied as follows: calcium 0.13 to 0.78%, phosphorus 0.12 to 0.36%, and magnesium 500 to 7,750 ppm. Treatment effects on fecal, urinary, plasma and bone mineral levels were observed. In two experiments, the utilization of oral Ca and P was measured. High dietary calcium increased calcium in plasma ($P<.05$) and feces ($P<.10$ to $P<.01$) and decreased magnesium in bone and plasma ($P<.05$). High calcium increased fecal phosphorus ($P<.01$) and tended to reduce plasma phosphorus. Excess dietary magnesium reduced plasma calcium ($P<.01$), appeared to increased fecal loss of calcium but had no effect on bone calcium. High magnesium increased the level of magnesium in urine ($P<.01$), plasma ($P<.05$ to $P<.01$) and bone ($P<.05$ to $P<.01$). High dietary phosphorus with a Ca:P ratio of 1:3 increased fecal calcium ($P<.05$), but, at a higher level of calcium with a Ca:P ratio of 1:1, phosphorus enhanced calcium retention. Supplemental phosphorus increased plasms phosphorus and reduced plasma calcium ($P<.01$). (East Central)

### 1191-A1, A6, A10, B2, D3, E1

**MOVE TO NEW LOCATION SOLVES MANY PROBLEMS FOR CUSTOM FEEDER,**
E. W. Manthey.
Feedlot Management, Vol 13, No 8, p 34-44, August, 1971.

Descriptors: *Relocation, *Farm wastes, *Feed lots, Arizona, Cattle.
Identifiers: Retention pond, Fly parasites, Biological fly control, Preconditioning, Feeding out and finishing.

Ecology and odor complaints from residents living near the Phoneix stockyards plus the problem of disposing economically of cattle wastes in an urban area were only two of the reasons why the Producers Livestock Marketing Association built a new feedlot of Maricopa. Another factor was plentiful nearby farmland which could absorb cattle-produced wastes in the new location at a fair return. The new feedlot was graded to include an anti-pollution pond for bacterial and anaerobic breakdown of animal wastes and for retention of the effluent on the land. A detailed description of the construction of the feedlot is given. Both the feeding out and finishing cattle process, and the preconditioning of stockers and feeders are discussed. Gnats (2 or 3 kinds that come from Africa) are used for biological fly control. (Dudley-East Central)

### 1192-A2, A4, B1, E1, F1, F2

**IMPLICATIONS OF WATER QUALITY LAWS FOR THE FEEDLOT INDUSTRY,**
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
Ron E. Shaffer, and Daniel E. Badger.
Oklahoma Current Farm Economics, March 1970, Vol 43, No 1, p 3-11. 2 tab, 19 ref.

Descriptors: *Water pollution control, *Pollution abatement, *Water management (Applied), *Water Quality Act, *Environmental effects, Lagoons, Water pollution effects, Waste disposal, Cost sharing, Legal aspects, Social aspects, Fertilizers, Benefits, Arid lands, Dry seasons, Waste dilutions, Stabilization, Dissolved solids, Oklahoma, Texas, Return (Monetary), Profit, Water utilization, Productivity, Streams, Legislation, Cattle, Water treatment, Waste treatment.
Identifiers: *Quality alteration, *Trade off, *Feed lot industry, *Beef feeding industry, *Feed Yards Act.

Agricultural water users historically considered the amount of wastes and impurities that could be discharged; recent emphasis is to keep pollutants from streams. Feedlot operators must integrate and coordinate the total production process to efficiently use resources for a profitable return. They must know what legal and social requirements they have in environmental protection through water management. Large-scale operations in Texas and Oklahoma, with up to 40,000 head capacity, predominate the beeffeeding industry. The Water Quality Act and Feed Yards Act require elimination of interstate water pollution and water-resource enchancement. Oklahoma requires feedlot licensees to provide reasonable waste disposal and drainage to avoid pollution. Feedlot runoff is discussed in terms of removing undesirable solids by stabilization lagoons and dilution. These methods present special problems in dry seasons and in arid lands. Waste disposal of manure as fertilize sales is not economical, but social and legal benefits of pollution-free rivers are high. Cost sharing waste control projects are outlined. Future feedlot locations must consider access to waste disposal as well as beef markets. Environmental quality is a dimension new to the industry, which will be developed when society can tradeoff between production efficiency and environment, or develop cost-sharing programs. (Popkin-Arizona)

### 1193-B2, C1, C2

**CHARACTERISTICS OF MILKING CENTER WASTE EFFLUENT FROM NEW YORK STATE DAIRY FARMS,**
Cornell Univ., Ithaca, N. Y. Dept. of Food Science.
R. R. Zall.
Journal of Milk Food Technology, Vol. 35, No. 1, p 53-55, 1972. 1 fig, 6 tab, 3 ref.

Descriptors: *Sewage effluents, *Waste identification, *Dairy industry, *Cattle, Effluents, Farm wastes, Biochemical oxygen demand, Water pollution sources, Nutrients, Nitrates, Nitrites.

Waste profile studies of milking center (milkhouse and milking parlor) wastes from twenty-four New York State dairy farms in 20 different countries were conducted to determine the characteristics and amounts of wastes. Composite samples were collected in small plastic swimming pools, and two-quart portions transported to the laboratory where biological and chemical analyses were performed. Waste volumes were physically measured at the farms. Sixty percent of the experimental sites sampled showed a sewage load of less than 10 lb. of BOD per day farm with approximately 4 gal of waste per cow per day from milking center operations. The amounts of nitrates and nitrites were no greater than the levels from sewage treatment plant effluents. Also, there were relatively small differences in soluble N and P compounds when compared with animals/farm or with pounds of BOD produced in milking centers. The principal solids in the wastes were manure, feed, bedding, and hood dirt. (Snyder-Battelle)

### 1194-A2, A3, A4, A11, A12, B1, C2, F1, F3, F4

**REVIEW OF NATIONAL RESEARCH POLICY ON EUTROPHICATION PROBLEMS,**
Water Pollution Research Lab., Stevenage (England).
A. L. Downing.
Journal of the Society for Water Treatment and Examination, Vol 19, Part 3, p 223-238, 1970. Discussion.

Descriptors: *Eutrophication, *Algal control, Financing, Plant growth, Toxicity, Nutrients, Water quality, Nitrates, Planning, Nitrogen, Phosphorus, Reservoirs, Fisheries, Water supply, Costs, Water demand, Economic justification, Aquatic weed control, Rivers, Agriculture, Rooted aquatic plants, Drainage, Runoff, Fertilizers, Livestock, Economics, Fish kills, Inhibitors, Water pollution sources, Human diseases.
Identifiers: *Research policy, *United Kingdom, *Future trends, Cladophora, Research strategy, Thames River (England), Lee River (England).

For new water supplies and for greater recreational exploitation of natural waters in the United Kingdom, appropriate levels of activity and lines of inquiry are needed. Cost incurred as a result of eutrophication will probably not increase to more than about double the present expenditures by this century's end. If algal and weed growth were fully understood, perhaps some comparatively simple preventive measures could be applied for eliminating these nuisances. A balanced program is required for basic research and for empirical investigations, especially on static waters. Since factors influencing algal growth vary geographically, examining the influences of location of water may show that one method of control may be more appropriate than another. Though it is unlikely elimination of phosphates from detergents would materially reduce algal problems, search for trouble-free substitutes should continue. Processes used in removing nitrogen and phosphorus from effluents should be examined for suitability of removing other substances (carbon adsorption, ozoniation), and ability of effluents to support algal growth by unsuspected components is profoundly important. Growth of weeds in rivers and effect of sewage effluent on Cladophora needs investigation. Insuring that present efforts are well coordinated takes precedence over embarking on many new initiatives. (Jones-Wisconsin)

### 1195-A2, A3, A4, A5, A9

**AGRICULTURAL POLLUTION OF WATER BODIES,**
Agricultural Research Service, Washington, D.C.
William M. Edwards, and Lloyd L. Harrold.
The Ohio Journal of Science Vol 70, No 1, p 50-56, Jan 1970.

Descriptors: *Water pollution, *Farms, *Livestock, *Phosphorus, *Nitrates, *Pesticides,

*Soil conservation, Runoff, Erosion, Percolation, Sediment, Waste.
Identifiers: Lake Erie, Barnyard, Solids, Liquids.

Pollution of Ohio's water bodies is of growing public concern; industrial, urban, and rural sources are becoming the subject of critical examination. Rural sources are soil sediment, plant nutrients, animal waste, and pesticides. Pesticides and phosphorus are absorbed rapidly and strongly to soil particles. Therefore reductions in sediment, phosphorus, and pesticide pollution are achieved by soil-erosion-control farming practices. More acres need to be brought under erosion-control practices. Nitrates dissolve in water and are carried by surface flow to streams and lakes, and by percolating water to underground aquifers. Increases in the use of nitrogen fertilizer, in evidence almost everywhere, could result in serious contamination of water bodies, if soil enrichment greatly exceeds the crop demand. Areas where large-scale livestock and poultry production is concentrated are also potential sources of serious pollution. In Ohio, animal-waste pollution problems are being studied at The Ohio State University, and movement of pollutants in surface and subsurface waters on drainage plots near Castalia are being studied by the Ohio Agricultural Research and Development Center and on agricultural watersheds by USDA Agricultural Research Service at Coshocton, Ohio. (Harrold-USDA, ARS)

### 1196-A2, A3, A4, A9, E1, F2

**CATTLE FEEDERS MUST COMPLY WITH ANTI-POLLUTION LAWS,**
R. Reiman.
The Cattleman, Vol. 58, No. 2, p. 43, 58, July 1971.

Descriptors: *Legal aspects, *Pollution abatement, *Agricultural runoff, *Return flow, *Waste disposal, Cattle, Permits, Discharge (Water), Animal wastes (Wildlife), Feedlots, Texas, New Mexico, Oklahoma, Irrigation water, Pollutants, Surface waters, Water pollution control, Sediment discharge, Erosion, Salinity, Fertilizers, Pesticides, Water quality control, Taxes.

Current federal anti-pollution laws for cattle feeders are reviewed. The Environmental Protection Agency (EPA) now requires that a permit be obtained from the Army Corps of Engineers before any discharges or deposits can be made into a navigable stream. The ruling applies to feedlots with more than 1,000 animal units and all new feedlots. It applies to at least 306 lots in Texas, 45 in New Mexico and 48 in Oklahoma. It is estimated that 10,000 beef cattle on a feedlot produce 200 tons of daily waste, comparable to a 100,000 to 200,000-person city. Agricultural runoff, irrigation return flow and confined feeding operations concern the EPA. The greatest quantity of pollutants in the surface waters of the country is sediment caused by erosion. Increased salinity concentration in receiving waters is a problem, especially when coupled with fertilizers and pesticides. Management of polluted waters is a growing research area. Some practices qualify for tax breaks. (Popkin-Arizona)

### 1197-A3, A4, A5, A12, E2

**NUTRIENT LOSSES FROM AGRICULTURAL LAND,**
Imperial Chemical Industries Ltd., Jealott's Hill (England). Jealott's Hill Research Station.
T. E. Tomlinson.
Outlook on Agriculture, Vol 6, No 6, p 272-278, 1971. 2 fig, 8 tab 19 ref.

Descriptors: *Eutrophication, *Agricultural runoff, Fertilizers, Nitrates, Percolation, Farm wastes, Drainage water, Feed lots, Nitrogen, Phosphorus, Potassium, Rivers, Leaching, Soil erosion.
Identifiers: Britain.

Considering problems of eutrophication and high nitrate levels specifically toxic to infants, a review was made of known nutrient losses from agricultural land and how these relate to farming, especially in England. Nutrients are lost from farmland by drainage water percolating through the soil leaching soluble plant nutrients, by inefficient return of livestock excreta to the land, and by erosion of surface soils or movement of fine soil particles into subsoil drainage systems. Lysimeter studies indicate that the nature of the cropping greatly influences loss of nitrate in drainage and confirm the possibility of large losses from soil reserves in certain circumstances. Many soils contain large reserves of nitrogen which can be released as nitrate over long periods of time, even if the soils are not cropped or fertilized. Phosphate levels of drainage water from soils are low, as illustrated by lysimeter studies. There is little danger that a large proportion of potassium fertilizer application will be lost in drainage. It is concluded that, at the present time, there do not seem to be grounds for serious concern about a general nitrate level rise in English rivers. (Jones-Wisconsin)

### 1198-A3, A5, C1, C2

**CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO, RUNOFF FLOWAGE,**
Eastern New Mexico Univ., Portales. Dept. of Biological Sciences.
Philip A. Buscemi.
Oikos, Vol 20, No 1, p 119-127, 1969. 3 fig, 3 tab, 30 ref.

Descriptors: *Runoff, *Groundwater, *Seston, *Sediments, Organic matter, Currents (Water), Water pollution sources, Surface runoff, Rainfall, Snowmelt, Surface waters, Streams, Hydrogen ion concentration, Iron, Magnesium, Nitrates, Phosphates, Algae, Detritus, Pulp wastes, Livestock, Idaho.
Identifiers: Tree bark, Charcoal, Algal growth, Stream concourse, Palouse River (Idaho).

Water and sediment samples were collected at four stations established on Palouse River, Idaho. Determinations included pH, nitrate, phosphate, iron, manganese, hardness, suspended detritus (drifting seston), and organic content of sedimentary deposits. The results show influence of rainfall, melt water, stream inflow, and mill pond on seston concentration. Variation in chemical composition of water indicated the effect of either melt water runoff or subterranean discharge. The increased pollution of water and sediment enrichment in organic matter were correlated with locations of lumber camps and cattle grazing. (Wilde-Wisconsin)

### 1199-A9, A11, A12, C2

**IMPROVED PROCEDURES FOR THE DETERMINATION OF OXYTETRACYCLINE IN MILK, MILK PRODUCTS; CHICKEN MUSCLE, LIVER; AND EGGS,**
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Biochemistry and Microbiology.
S. E. Katz, and C. A. Fassbender.
Bulletin of Environmental Contamination and Toxicology, Vol 7, No 4, p 229-236, April 1972. 8 tab, 6 ref.

Descriptors: *Antibiotics (Pesticides), *Analytical techniques, *Evaluation, *Pollutant identification, *Milk, *Poultry, Organic pesticides, Methodology, Centrifugation, Bioassay, Pesticide residues, Methodology, Foods.
Identifiers: *Biological samples, *Oxytetracycline, Milk products, Tissues, Muscle, Liver, Eggs, Detection limits, Bioaccumulation, Recovery, Chlortetracyline.

The improved procedures for determining oxytetracycline in milk and dairy products, chicken muscle tissue and livers, and eggs are evaluated. The procedures used were based upon those developed for chlortetracycline in similar materials and are compared to the procedures listed in the FDA compendium of methods and protocols. The procedural improvements include pH adjustment, centrifugation, single agar layer, high temperature seeding and spreading of agar, and the use of a surfactant. A summary of the detection limits and analytical measurement for the individual procedures shows that the centrifuge modification, pH adjustment where applicable, and the use of surfactant when necessary have significantly improved the ability to measure residues of oxytetracycline in milk, eggs, and chicken tissue. (Holoman-Battelle)

### 1200-A4, C3

**PROGRESSIVE CHANGES IN THE CLADOCERAN AND MIDGE FAUNA DURING THE ONTOGENY OF ESTHWAITE WATER,**
Indiana Univ., Bloomington.
Clyde E. Goulden.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 15, p 1000-1005, 1964. 2 fig, 13 ref.

Descriptors: *Midges, *Lakes, Eutrophication, Pollen, Sediments, Climates, Productivity, Sheep, Hypolimnion, Anaerobic conditions, Daphnia.
Identifiers: *Esthwaite Water (England), *Cladocera, *Ontogeny, Chydoridae, Daphniidae, Bosminidae, Sididae, Polyphemidae, Leptodoridae, Deforestation, Chironomus, Sergentia, Tanytarsus, Ceriodaphnia.

Changes in total populations throughout Esthwaite Water's history and successional changes of Cladocera and midges associated with eutrophication are discussed. The Cladocera species were divided into the 'chydorids' and the 'non-chydorids,' mostly planktonic in habit. The Cladocera and midges suggest that Esthwaite Water was an oligotrophic lake during most of its development and only within the last 900 years became eutrophic under man's influence. Further, they indicate there were four periods of increased productivity during the lake's development associated with climatic or cultural changes in the drainage basin. Greater productivity is expected in these intervals, and the fact that the Cladocera correctly suggest this implies that they can be of great usefulness for determining past productivity in lakes. Cladoceran remains in lake sediments appear to be a valuable tool for paleolimnologists. They may be used to determine periods of climatic and cultural changes and for deducing past limnological conditions of a particular body of water. By studying the distribution and abundance of individual species in the sediment, we can estimate the ecological requirements of these species. This in turn will suggest fruitful areas of further research on living forms. (Jones-Wisconsin)

### 1201-A2, A4, F2

**OKLAHOMA FEED YARDS ACT.**
Oklahoma Statutes Ann Title 2, secs 9-208, 9-210 (Supp 1970).

Descriptors: *Oklahoma, *Water pollution, *Water pollution control, *Surface drainage, Surface waters, Surface runoff, Water pollution sources, Livestock, Pollutants, Water quality control, Domestic animals, Agriculture, Legal aspects, Legislation.

Each licensed feed yard operator is required by this statute to provide adequate drainage for surface waters; avoid pollution of any stream, lake, river, or creek; and provide reasonable methods for the disposal of animal excrement. (Madsen-Florida)

### 1202-A3, A5, A9, F2

**OWENS V. UNITED STATES (LIABILITY OF UNITED STATES FOR NEGLIGENT APPLICATION OF INSECTICIDE, POLLUTING POND OF ADJACENT LANDOWNER).**

294 F. Supp. 400-405 (S.D.Ala. 1968).

Descriptors: *Alabama, *Water pollution, *Insecticides, *Rainfall, Cattle, Ponds, Streams, Federal government, Administrative agencies, Rain, Legal aspects, Judicial decisions, Water pollution effects, Water pollution sources, Pollutants, Water wells, Damages, Remedies, Regulation.

Plaintiff cattle rancher sought to recover damages for injury to his herd from defendant United Status under the Federal Tort Claims Act. Plaintiff's property included part of a small pond from which the cattle watered. The pond was supplied from rainfall and water drainage. A dry-bed drainage creek drained into the pond. Federal Department of Agriculture employees treated the property adjoining plaintiff's with a chemical insecticide. Thereafter, a heavy rainfall occurred which washed this insecticide into the dry-bed creek, and ultimately to plaintiff's pond. The pond was fenced off, and the cattle were not poisoned. Nevertheless, plaintiff claimed damages from loss of part of his pasture, reduced milk production, increased food cost, and the expense of drilling a well for water. Defendant contended that plaintiff's injury resulted from the rainfall, an act of God, and that it was not liable. The Federal District Court however, determined that under Alabama law an act of God would not render defendant immune where its negligence was also an acutal cause of plaintiff's injury. Since the court concluded that defendant's negligence was an actual cause of the injury, defendant was held liable. (Hart-Florida)

### 1203-A4, A12, F2

**FOULING OF WATERS A MISDEMEANOR.**

North Dakota Century Code Ann secs 61-01-12 thru 61-01-14 as amended (Supp 1969).

Descriptors: *North Dakota, *Water pollution sources, *Water pollution control, *Waste disposal, Water quality, Water quality control, Wastes, Industrial wastes, Refuse, Sewage effluents, Gasoline, Oil wastes, Farm wastes, Cattle, Sheep, Hogs, Sewage disposal, Streams, Rivers, Public health, Administrative agencies.

Section 61-01-12 provides that the fouling of public waters by depositing gas tars or other refuse from any gas house into streams, rivers or sewers that empty into public waters is a misdemeanor. Section 61-01-13 provides the fouling of public waters with dead animals, offal, or other refuse by depositing same on the banks or in any lake or stream within the jurisdiction of the state is a misdemeanor punishable by a fine of from $20 to $100. Section 61-01-14 provides that section 61-01-13 shall be construed to include: (1) privies and privy vaults; (2) any stable, shed, pen, yard, or corral where farm animals are located within sixty feet of the top of any lake or stream; and (3) any slaughterhouse, graveyard or cemetery within eighty feet of these waters. However, in an emergency, these provisions do not prevent any municipality from dumping untreated sewage into these waters provided they are not determined detrimental to public health. (Rees-Florida)

### 1204-A2, A4, F2

**OHIO STOCK FOOD CO V GINTLING (STREAM POLLUTION BY UPPER RIPARIAN HOG FARM).**

153 NE 341-345 (Ohio Ct App 1926).

Descriptors: *Ohio, *Municipal wastes, *Garbage dumps, *Pollution abatement, Water pollution, Wates disposal, Legal aspects, Judicial decisions, Streams, Hogs, Riparian water, Riparian land, Riperian rights, Farms, Farm wastes.

Defendant corporation owned a farm one mile from plaintiff's farm. Defendant, under contract with a municipality, received the city's garbage and disposed of it by feeding it to hogs. A stream flowed through defendant's property, then passed through plaintiff's land. Plaintiff brought a nuisance action for damages, alleging that during the operation of its farm, defendant polluted the stream through drainage of liquid, filth and refuse. Defendant contended that its acts in the operation of its farm were authorized by law, inasmuch as it had a contract with a municipality to dispose of the garbage. The Ohio Court of Appeals held that plaintiff was liable for damages, notwithstanding the municipal contract. An upper proprietor of land cannot by artificial means pollute a stream to the injury of a lower riparian owner. (Powell-Florida)

### 1205-A2, A4, F2

**SUMNER V O'DELL (INJUNCTION TO PREVENT POLLUTION OF SPRING WATER BY CATTLE).**

12 Tenn App 496-500 (1930).

Descriptors: *Tennessee, *Water pollution, *Streams, *Reasonable use, Cattle, Domestic water, Riparian rights, Water quality, Spring waters, Springs, Legal aspects, Judicial decisions, Water pollution sources, Remedies, Relative rights.

Plaintiff lower riparian landowner sought to enjoin defendant upper riparian landowner from polluting the stream bordering their property. Plaintiff's and defendant's tracts were previously owned by one person, who conveyed plaintiff's tract first, along with the right to use the spring water flowing from defendant's tract. When defendant purchased the upper tract, he began using the lot through which the stream flowed as a confinement for cattle. The cattle polluted the water so that it was unfit for plaintiff's domestic uses. Apparently defendant's actions were purposeful, and with some malice, since the evidence presented clearly showed that defendant could have erected his fences to prevent pollution of the spring water. The Tennessee Court of Appeals held that defendant was utilizing his property unreasonably with respect to plaintiff's rights, and enjoined use of the lot as a cow pasture and path. (Hart-Florida)

### 1206-A4, F2

**POLLUTION OF STREAMS.**

Del Code Ann tit 16, secs 1301, 1302 (1953).

Descriptors: *Delaware, *Water pollution, *Streams, *Water pollution sources, Pollution abatement, Public health, Wastes, Industrial wastes, Water quality, Chemcontrol, Sewage, Organic wastes, Legislation, Judicial decisions, Water supply, Hogs, Water quality control.
Identifiers: Dye-stuffs, Slaughter houses.

No person shall discharge or allow any dye-stuffs, drugs, or chemicals which cause the stream to become noxious to the health or disagreeable to the senses to escape into any stream used as a water supply. In addition to imposing a fine for violation, the court shall also issue an abatement order within 20 days after conviction. The abatement shall be enforced by the sheriff. No person shall place a privy, hog-pen or slaughter house so as to pollute any stream with the excrement or offal therefrom. Violators shall be fined and the court shall order the nuisance abated immediately. (Helwig-Fla)

### 1207-A4, A5, A10, A12, F2

**FAIRES V DUPREE (WATER POLLUTION FROM ANIMAL WASTES).**

197 SW 2d 735-738 (Ark 1946).

Descriptors: *Arkansas, *Hogs, *Animal wastes, *Water pollution, Cold springs, Farm wastes, Impaired water quality, Public health, Seepage, Damages, Legal aspects.
Identifiers: *Damages (Legal aspects).

Plaintiff brought action for damages resulting from the operation of a hog ranch in an unsanitary manner on land situated adjacent to plaintiff's property. The court found there was insufficient evidence to show an ascertainable monetary loss to plaintiff's spring from defendant's operation of a hog farm near plaintiff's land in such a manner that seepage from garbage washed down filling plaintiff's spring, polluting the water, and infecting it with maggots. However, evidence that plaintiff had periods of vomiting, nausea, and general debility presented a question for the jury as to whether plaintiff's illness was caused by the imposition of stench, flies, and filth or whether plaintiff was overstating the corrupting causes. Therefore, case was reversed and remanded for new trial. (Reed-Fla)

### 1208-A4, F2

**GREEN V MCCLOUD (ACTION TO ENJOIN SEWAGE FLOW).**

303 Ky 207, 197 SW 2d 258-261 (1946).

Descriptors: *Kentucky, *Domestic wastes, *Water pollution, Prescriptive rights, Sewage sludge, Sewage effluents, Livestock wastes, Disposal, Farm wastes, Decomposing organic matter, Riparian waters, Dairy industry, Distribution systems, Nuisance (Water law), Legal aspects, Judicial decisions, Poultry.

Plaintiff brought suit to enjoin defendant from interfering with a sewer line which belonged to plaintiff and another. Defendant filed a counterclaim, consolidated with an action against two others to enjoin them from allowing sewage from residences and outbuildings to run through open ditches or buried pipes in the bed of small stream near defendant's property. From adverse judgments, defendant appealed. While there is no prescriptive right to maintain a nuisance, the fact that defendant moved onto the land upon which the nuisance existed is an important factor to be considered in determining the equities. The court found that the evidence authorized a finding that the sewer line emptying sewage from residences and outbuildings into the small stream did not constitute a nuisance which would be enjoined and consequently affirmed the judgments. (Reed-Fla)

### 1209-A2,A4,A5,C2,C3,F2

**ATKINSON V HERINGTON CATTLE CO (FEED LOT OPERATOR'S AND CATTLE OWNER'S JOINT LIABILITY FOR CATTLE WASTE RUNOFF).**

436 P2d 816-828 (Kan 1968)

Descriptors: *Cattle, *Waste water (Pollution), *Damages, *Kansas, Water pollution sources, Farm wastes, Pollution abatement, Surface runoff, Water pollution effects, Water pollution control, Remedies, Legal aspects, Judicial decisions, Livestock, Stock water, Water supply, Water wells, Coliforms, Sewage bacteria, Nitrates.

In an action for damages arising from the pollution of plaintiff dairy farm owner's water supply by defendant cattle rancher's feeding operations, the Kansas Supreme Court held that the evidence was sufficient to support a judgment for actual, but not punitive, damages. The court agreed with plaintiff's contention that there was ample evidence to find that the waters of a creek and plaintiff's well were contaminated with coliform bacteria and nitrates following a runoff of rains from defendant's premises. The supreme court construed the lower court's ruling to mean that runoff becomes a harmful substance when it consists of contaminating bacteria and chemicals in such amounts as to produce excessive pollution which results in injury. The fact that a business is lawful does not exempt it from liability when contaminated or polluted water escapes onto the land of another in such quantities as to cause injury. The owner of the cattle being fed by defendant rancher was held jointly and severally liable since the bailment contract with defendant rancher vested essential control over the operation in the cattle owner-bailor. (Gallagher-Florida)

### 1210-A4, A5, A11, A12, A13, F2

**MEASURE AND ELEMENTS OF DAMAGES FOR POLLUTION OF A STREAM,**
W. R. Habeeb.
49 ALR 2d 253-314

Descriptors: *Judicial decisions, *Damages, *Water pollution, Reasonable use, Value, Market value, Depreciation, Economic rent, Water utilization, Odor, Trees, Crops, Recreation, Boating, Swimming, Fish, Livestock.

Elements to be considered when measuring damages for stream pollution are examined. Where permanent or irreparable damage results, recovery may be had for the depreciation of market value of the property. However, where the damage can be remedied at a cost lower than the loss in market value, the cost of such repair becomes the measure of damages. Where the pollution is temporary or abateable, the measure is the depreciation in the rental or usable value of the property. Special damages may also be recovered, as may punitive damages, depending upon the particular circumstances. Particular items of damages such as impairment of use and enjoyment of property, noxious odors, discomfort and inconvenience, sickness, trees, crops, deprivation of use of water, recreation privileges, fish, death and injury of livestock, injury to business, expense of repairing injury, fencing, procuring water, expense of mill operations, and others are also examined. (S. Scott-Fla)

### 1211-B1

**ELECTRIC POTENTIALS AND DOMESTIC WATER SUPPLIES,**
Washington State Univ., Pullman.
L. B. Craine, M. H. Ehlers, and D. K. Nelson.
Agricultural Engineering, Vol 51, p 415-417, July 1970, 2 fig, 1 tab.

Descriptors: *Water supply, Agricultural engineering, *Cattle, Electrical grounding, Water consumption, Electrical networks, Electric currents.
Identifiers: *Electrical potential, Voltage.

Electric potentials on domestic water systems affected water consumption and productivity of cattle. The problem of annoying voltage resulted from a single-phase two-wire multiple-grounded system with primary distribution and secondary utilization neutrals solidly bonded together. The problem was solved by separation of grounded neutrals of the primary distribution system from the farm secondary system. An electrified fountain system was built to test effects of controlled water system voltages on animal water consumption. At current levels of 19 ma and at a level of 8 volts the cattle would not drink for an 8 hour period. (Galwardi-Texas)

### 1212-A3,A4,B4,C2,C3

**EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH-MOUNTAIN WATERSHEDS: BACTERIOLOGICAL INVESTIGATIONS OF MOUNTAIN STREAMS,**
Montana State Univ., Bozeman. Dept. of Botany and Microbiology.
D. G. Stuart, G. K. Bissonnette, T. D. Goodrich, and W. G. Walter.
Applied Microbiology, Vol. 22, No. 6, p 1048-1054, December 1971. 6 fig, 2 tab, 15 ref.

Descriptors: *Water quality, *Watersheds, *Mountains, *Bacteria, *Water pollution sources, *Watershed management, Coliforms, Enteric bacteria, Cultures, Sampling, Nutrients, Montana, Recreation, Animal wastes, Streams, E. coli, Lumbering, Camping, Water supply, Wildlife, Chemical analysis, Salmonella, Pathogenic bacteria, Shigella, Filtration.
Identifiers: Enterobacter aerogenes, Hyalite watershed, Mystic watershed, Proteus, Streptococcus faecium var durans, Streptococcus faecalis var liquefaciens, Streptococcus bovis.

Bacteriological studies in 1968 and 1969 corroborated earlier findings that a municipal watershed which had been closed to public entry since 1917 yielded water with four to six times the coliform count found in an adjacent mountain watershed open to recreational activities. Similarly, chemical investigations showed higher concentrations of most ions in water from the closed area. Physiological differentiation of coliform and enterococcal bacteria revealed similar types of organisms in both animal droppings and stream, with fecal coliforms accounting for as much as 70 percent of the coliform counts observed in the closed area in 1969. Opening of the closed drainage for limited recreation and expanded logging operations in the spring of 1970 coincided with an unexpected decrease in bacterial contamination of that stream. It is postulated that these human activities drove from the watershed a large wild animal population which had contributed substantially to the previous bacterial pollution. It would seem that the practice of closing high-mountain watersheds to public entry is questionable if governmental standards for water quality are to be met, and it also seems that the standards themselves should be reexamined. (Jefferis-Battelle)

### 1213-C3, F6

**A COMPUTER PROGRAM FOR IDENTIFYING MICROORGANISMS,**
Quincy Coll., Ill.
W. Gasser, and K. M. Gehrt.
BioScience, Vol. 21, No. 20, p 1044-1045, October 15, 1971. 3 tab, 7 ref.

Descriptors: *Pathogenic bacteria, *Enteric bacteria, *Computer programs, Programming languages, *Pollutant identification, Microorganisms, Computer models, Automation, E. coli, Data processing, Pseudomonas, Salmonella, Streptococcus.
Identifiers: Proteus vulgaris, Pseudomonas aeruginosa, Alcaligenes faecalis, Serratia, Serratia marcesens, Salmonella typhosa, Klebsiella, Klebsiella pneumoniae, Staphylococcus, Staphylococcus aureus, Sarcina lutea, Diplococcus pneumoniae, Streptococcus pyogenes.

A computer program has been developed to identify microorganisms from test results. Results from standard microbiological tests (e.g. gram stain, glucose fermentation) are used in the program. Where many organisms are identified from limited test results, results from additional chemical tests may be entered for complete identification. Some of the advantages of the program are: ability to handle several sets of input data, easy program modification, and the need for minimal programming knowledge. An identification matrix is included for E. coli, Proteus vulgarus, Pseudomonas aeruginosa, Alcaligenes faecalis, Serratia marcesens, Salmonella typhosa, Klebsiella pneumoniae, Staphylococcus aureus, sarcina lutea, Diplococcus pneumoniae, Streptococcus pyogenes. (Mackan-Battelle)

### 1214-A2, A3, B2, C2, D2, D3, E1, E2

**THE DISPOSAL OF AGRICULTURAL WASTE,**
Douglas Gowan.
Effluent and Water Treatment Journal, p 303-308, June 1971. 2 tab, 10 ref.

Descriptors: *Waste disposal, *Farm wastes, Water pollution, Fertilizers, Farm management, Livestock, Economics, Copper, Arsenic compounds, Odor, Sewers, Biochemical oxygen demand, Slurries, Chlorides, Ammonia, Nitrogen, Dairy industry.
Identifiers: United Kingdom, Farm income.

The present United Kingdom laws make it unlawful to discharge farm drainage into a stream without consent of river authorities; river authorities also have power to control pollution of underground water. Over 131,000 farm discharges to watercourses in the United Kingdom are known, the combined effect posing serious consequences. The basic need is cheaper methods of dealing with manure and other wastes from large animal concentrations. Cattle wastes have quite different characteristics from domestic wastes and chemical residues from feed additives can give rise to serious difficulties in the effects on biological treatment processes. To control odor of animal excreta, ammonium persulphate has proven effective. Farm wastes disposal onto land and into public sewers are discussed and population equivalents are considered. Every farm is different and must be treated individually for assessing charges for reception and treatment in the public sewer. Discharges from dairy farms and from mixed farms are tabulated. Today local authorities have the means of obtaining relatively accurate information for design of treatment plants as well as for the assessment of charges. (Jones-Wisconsin)

### 1215-C2, D2, D3, F6

**AUTOMATED COMBUSTION VERSUS DIGESTION FOR TRITIUM MEASUREMENT IN BIOLOGICAL SAMPLES,**
Agricultural Research Service, Kerryville, Tex. Toxicological Research Lab.
L. M. Hunt, and B. N. Gilbert.
International Journal of Applied Radiation and Isotopes, Vol 23, No 5, p 246-249, May 1972. 1 fig, 2 tab, 8 ref.

Descriptors: *Digestion, *Tritium, *Automation, Chemical analysis, Bioassay, Pollutant identification, Suspension, Quenching, Aqueous solutions, Animal wastes, Solvent extractions, Water pollution sources, Thiocarbamate pesticides, Sheep.
Identifiers: *Biological samples, *Combustion, Ferbam, Tissue, Recovery, Liquid scintillation, Sample preparation, Lungs, Pancreas, Bone, Heart, Brain, Spleen, Muscle, Liver, Kidneys, Feces, Blood.

In order to find the most feasible method for analyzing tritium-tagged biological samples, the more frequently used techniques for noncombustion preparation, digestion, suspension, and extraction were compared with the automated combustion method. Sheep tissues were collected and prepared, and ferbam, a dithiocarbamate fungicidal compound, was used for recovery determinations. With the automated combustion method, the mean recovery for the first eight tissues at the 25 milligram level was 95 percent compared to 69 percent using digestion. When the sample sizes were increased, a notable difference in the comparison was apparent, as the percentage recovery was 82 percent for combustion and 40 percent by digestion. It appeared that digestion rather than combustion of the 25 milligram muscle samples was superior. No corrections were made for quenching in order to get a true comparison of the two methods of analysis. The disparity in methodology became marked with sample sizes of 50 and 100 micorliters with combustion maintaining a high efficiency, while digestion significantly decreased as sample size increased. Combustion had the advantage of speed (8-10 minutes per sample) with no clean-up between combustions. (Byrd-Battelle)

### 1216-C3, F6

**IDENTIFICATION OF METABOLITES OF N - (1, 1-DIMETHYLPROPYNYL) - 3,5 DICHLORBENZAMINE IN RAT AND COW URINE AND RAT FECES,**

Rohm and Haas Co., Springhouse, Pa., Research Labs.
Roy Y. Yih, and Colin Swithenbank.
Journal of Agricultural Food Chemistry, Vol. 19, No. 2, 1971 p 320-324, 3 fig., 3 tab., 7 ref.

Descriptors: *Farm wastes, Laboratory tests, Chemical analysis, Metabolism, Radioactivity techniques, *Pollutant identification.
Identifiers: *Metabolic pathways, Chemical structure, Metabolites.

This is the continuation of studies to determine the comparative metabolism of N- (1,1-dimethylpropynyl)-3,5-dichlorobenzamide in soil, plants, and animals. Nine metabolites were identified in soil and alfalfa treated with this compound. This study concerns the isolation, identification and synthesis of these metabolites in rat and cow urine and rat feces. Tentative metabolic pathways and its comparative metabolism in soils, plants, and mammals are postulated. (Christenbury-Iowa State)

### 1217-A4, A12, C3, F2

**APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY,**

E. Geldreich.
Journal of the American Water Works Association, Vol 62, No 2, p 113-120, Feb 1970. 8 p, 53 ref.

Descriptors: *Recreation, *Bioindicators, *Water quality, *Bacteria, Aquatic bacteria, Aquatic microbiology, Aquatic microorganisms, Coliforms, Salmonella, Streptococcus, Water pollution, Water pollution sources, Pollutant identification, Path of pollutants, Animal wastes (Wildlife), Public health, Standards, Farm wastes, Water zoning, Sediment-water interfaces, Domestic wastes, Legal aspects, Sewage bacteria, Pathogenic bacteria.
Identifiers: *Fecal pollution.

Fecal contamination from all warm-blooded animals is the natural link to pathogenic microorganisms in polluted water. The fecal coliform test accurately detects and measures such fecal contamination. Use of the fecal coliform test as a measure of recreational water quality is recommended. Data and tables are given to show a correlation between fecal coliform and the probable occurance of Salmonella, an easily detecting pathogen. Court hearings are cited that establish the legal status of the fecal coliform test. The water-sediment interface of a stream or lake bottom can serve as a reservoir for fecal pollution 'fallout' from overlying water. The fecal-streptococcus group's diverse survival rates and specific fecal origins make them specific indicators for nonhuman, warm-blooded, animal pollution. Various minimal bacterial densities are suggested to insure good recreational water quality. (Cuevas-Florida)

### 1218-A4, A9, A12, B1, D1, E3, F3

**FUTURE WATER QUALITY DESIGN,**

California State Department of Public Health, Berkeley.
Frank M. Stead.
Journal of the American Water Works, Vol. 59, No 12, December 1967, pp. 1497-1501.

Descriptors: Water quality, *Water pollution, *Water quality management, Stream conditions, Standards, Industrial wastes, Public health, Water pollution sources, Municipal wastes, *Waste water disposal, Benefits.
Identifiers: Pathogens, Pesticide pollutions, Total management, Aquatic system.

Pollution control alone will not preserve water quality in the U.S. because it is based on a concept of disposal of wastewaters from municipalities and industries. In both cases the sewage is no longer wanted, and most often put back into the rivers. With half the total annual water replenishment put to use and converted to wastewater, it is important to consider how much dilution is necessary to keep waters up to present standards. There are three basic choices; (1) discharge the entire waste stream to the ocean or evaporate it, (2) through treatment bring the wastewater up to a sufficient level of quality so that when it is diluted it meets standards for all uses, (3) through treatment bring each individual waste stream up to the standard of quality for a specific use and put resulting 'reclaimed' water to that use directly, without returning it to either surface or ground waters. Current standards concerning pathogens and pesticides have not been given enough study to really indicate possible impairment of human health. What is needed is a new water policy for the U.S. -a policy involving total management of water resources. The entire aquatic system must be analyzed and a new system of distribution in terms of benefits must be devised. (Gargola-Chicago)

### 1219-A2, A3, A4, A5, A6, A7, A11, A12, C2, D2

**NITRATES IN THE ENVIRONMENT,**

Wisconsin Univ., Madison. Dept. of Civil Engineering.
M. Starr Nichols.
Journal American Water Works Association, Vol 57, No 10, p 1319-1327, 1965. 25 ref.

Descriptors: *Nitrogen, *Atmosphere, *Biosphere, Fertilization, Nitrogen fixation, Denitrification, Wastes, Nitrogen fixing bacteria, Ammonia, Odor, Aquatic plants, Groundwater, Toxicity, Waste treatment.
Identifiers: Nitrogen deposits, Mineralization, Methemoglobinemia, Livestock poisoning, Silage gas, Odor prevention.

Atmospheric nitrogen, supplying 1600 pounds of elemental nitrogen per square foot of the world, is the most important source of nitrogen fertilizer. Nonsymbiotic and symbiotic nitrogen-fixing organisms fix nitrogen in the biosphere from atmospheric supplies. These organisms include 10 species of bacteria and 6 strains of blue-green algae. Denitrifying organisms cycle nitrogen back to the atmosphere. Nitrifying organisms, such as Nitrobacter, oxidize organic nitrogenous compounds in waste matter to nitrate after ammonification occurs. Mineralization of nitrogen in waste matter is responsible for most nitrogen mineral deposits found in the world. Slightly alkaline buffered environment and aerobic conditions will produce nitrates at enormous rates to supply nutrient needs. Aquatic growths in lakes from over-fertilization may be nature's method of conserving nitrogen fertilizer. Presence of nitrogen compounds can indicate pollution. Nitrate concentration above 45 ppm might cause methemoglobinemia. Livestock is susceptible to nitrate poisoning. Sodium nitrate added to waste treatment lagoons limits odors and enhances biochemical oxygen demand reduction. Nitrates are added to natural water by leaching and runoff from wastes and poorly managed fertilizing practices. (Bannerman-Wisconsin)

### 1220-A9, B1, F3

**WATER POLLUTION RESULTING FROM AGRICULTURAL ACTIVITIES,**

Clemson Coll., S.C. School of Agriculture.
H. J. Webb.
Journal of the American Water Works Association, Vol 54, No 1, p 83-87, January 1962. 2 tab, 10 ref.

Descriptors: *Water pollution sources, *Farm wastes, *Pesticides, *Farm lagoons, *Fertilizers, Chlorinated hydrocarbons, Nitrates, Insecticides, DDT, Sewage lagoons, Waste disposal, Fertilization, Farm management, Crop production, Lime, Phosphates, Livestock, Hogs, Confinement pens, Fish, *Feed lots.

Farm practices are changing to grow more crops on less land, and produce more animals in a smaller area. More fertilizers and pesticides are needed to do this with the result that water quality is affected. Animal wastes will increasingly be a problem in terms of disposal and treatment. Feed yard waste treatment facilities often lack adequate design. Pesticides, especially the chlorinated hydrocarbons, pose increasingly serious problems for fish life. Traditional treatment methods are not effective in removing many of these pollutants from domestic water supply systems. More research and information is needed on the effects of the evolving farm practices on water quality. (Flack-AWWARF)

### 1221-C2

**DETERMINATION OF MERCURY IN FOOD PRODUCTS AND BIOLOGICAL FLUIDS BY AERATION AND FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY,**

Michigan Dept. of Agriculture, Lansing.
V. A. Thorpe.
Journal of the Association of Analytical Chemists, Vol. 54, No. 1, p 206-210, 1971. 3 fig, 4 tab, 4 ref.

Descriptors: *Mercury, *Pollutant identification, Foods, Fish, Chemical analysis, Acids, Chemical reactions, Oxidation, Feeds, Milk, Poultry, Reduction (Chemical), Calibrations, *Aeration.
Identifiers: *Biological samples, Potassium permanganate, Stannous chloride, Sulfuric acid, Reagents, Blood, Urine, Meat, Eggs, *Atomic absorption spectrophotometry, Precision, Sample preparation, Chemical recovery.

A modification of a method developed at the Fisheries Research Board of Canada has been used for determining mercury in fish, water, other food products, and biological fluids such as meat, poultry, eggs, milk, urine, blood, and animal foods. Samples were wet digested at 50 C with sulfuric acid, oxidized with strong potassium permaganate solution, and reduced with stannous chloride. Flameless atomic absorption spectrophotometry was used to measure vapor, and to compare sample results with prepared standards and standard curves. Replication of analyses on different days showed good precision, and in testing samples spiked with known amounts of mercury results showed adequate recovery. (Mackan-Battelle)

### 1222-D2

**PEPSIN DIGESTIBILITY METHOD FOR ANIMAL PROTEINS. 1971 COLLABORATIVE STUDY,**

Moorman Mfg. Co., Quincy, Ill.
A. J. Gehrt.
Journal of the Association of Official Analytical Chemists, Vol 55, No 4, p 702-706, 1972. 1 tab, 4 ref.

Descriptors: *Digestion, *Filtration, *Analytical techniques, *Protein, Centrifugation, Poultry, Nitrogen compounds, Organic compounds, Chemical analysis, Methodology, Quality control.
Identifiers: *Pepsin, *Interlaboratory tests, Collaborative studies, Biological samples, Method validation, Data interpretation.

Twenty collaborating laboratories evaluated a new method of filtering residues from a pepsin digestibility test of animal proteins. When the first action method was modified by more detailed filtering instructions, the analysts found increased sensitivity and reproducibility. Based on the data from the collaborative studies the method has now been adopted as official first action for poultry by-product meal and hydrolyzed feathers and as final action for other animal proteins. (Mortland-Battelle)

### 1223-A9, A11, D2

**EFFECT OF DURSBAN IN THE DRINKING WATER OF CHICKS,**
Manitoba Univ., Winnipeg. Dept. of Entomology.
R. A. Brust, S. Miyazaki, and G. C. Hodgson.
J Econ Entomol. Vol 64, No 5, p 1179-1183. 1971. Illus.
Identifiers: *Poultry, Blood, *Dursban, Cholin esterase, Water pollution effects.

The insecticide Dursban (0,0-diethy 0- (3,5,6-trichloro-2-pyridyl) phosphorothioate), was added to the drinking water of young Leghorn cockerels at 8 levels ranging from 0.08 to 1280 ppm active ingredient. Experiments were begun with chicks 3 or 5 days old and were concluded after 3 and 4 wk. Mortality at 80 ppm was 20%, and mortality at 320 and 1280 ppm was 100%. No adverse effects were apparent at lower levels. Solvent and inert ingredients of Dursban emulsifiable concentrate had no adverse effect on the chicks up to 717.7 ppm. Cholinesterase activity in whole blood was monitored at all treatment levels, and the activity decreased at 80 ppm Dursban and above. At lower levels there was no significant difference from the controls. Weight gain/day diminished with increased levels of Dursban. Starvation of treated chicks did not affect blood-cholinesterase activity.--Copyright 1972, Biological Abstracts, Inc.

### 1224-A3, A4, B1, C3, E2

**FACTORS AFFECTING THE CONCENTRATION OF FAECAL BACTERIA IN LAND-DRAINAGE WATER,**
West of Scotland Agricultural Coll., Auchincruive (Scotland). Dept. of Microbiology.
M. R. Evans, and J. D. Owens.
Journal of General Microbiology, Vol 71, No 3, p 477-485, August 1972. 4 fig, 8 ref.

Descriptors: *Drainage water, *Farm wastes, *Environmental effects, *Subsurface drainage, *Enteric bacteria, Subsurface waters, Hogs, Flow rates, Equations, Water pollution sources, Percolation, Soil water movement, Seepage, Pollutant identification, Biochemical oxygen demand, E. coli, Filtration, Membranes, Discharge (Water), Weir gauges, Clay loam, Sands, Surface runoff.
Identifiers: Enterococci, Biochemical tests, Fecal coliforms.

The rate of discharge and the concentration of faecal bacteria in the water from a subsurface field drain were monitored by standard techniques initially for one winter without application of animal excrement to the pasture, and, subsequently, for two winters when pig excrement was sprayed over the pasture. The concentrations of Escherichia coli and enterococci in the water were affected by three main factors: the flow rate of the drain discharge; the number of bacteria in or on the soil and vegetation; and the application to the land of large volumes of semiliquid animal excrement over short periods of time. In the absence of excrement application, the concentration of faecal bacteria in the water was related to the flow rate and to time by an equation of the form: log bacterial concentration equals a plus b log flow rate minus c days, where a, b and c are constants. The concentrations of bacteria in the water declined with time, the 90 percent reduction times being 57 days for E. coli and 96 days for enterococci. The spraying of pig excrement over the pasture resulted in a 30- to 900-fold increase in the concentrations of faecal bacteria in the drain discharge within 2 h of the start of the spraying. The concentrations of faecal bacteria returned to their normal levels over a period of 2 to 3 days. (Byrd-Battelle)

### 1225-A2, A3, A4, A9, F1

**CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT,**
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
Cecil H. Wadleigh, and Clarence S. Britt.
Journal of Soil and Water Conservation, Vol 24, No 4, p 172-175, Oct 1969. 4 p, 4 ref.

Descriptors: *Water resource development, *Water pollution, *Eutrophication, Government supports, Soil conservation, Industrial wastes, Municipal wastes, Fertilizers, Pesticides, Soil erosion, Animal wastes, Economics, Nitrogen, Water conservation.
Identifiers: *Soil runoff, Livestock.

Some of the problems involved in natural resource conservation are presented, with particular emphasis on the water pollution caused by agricultural runoff and livestock production. It is pointed out that the economics of the farming and livestock industry are often in conflict with the conservationists' interests. It is suggested that the Dept of Agriculture adopt a cost-sharing program to encourage solutions to some of the problems. The article emphasizes the dangers of eutrophication induced by animal wastes. The author concludes with a statement of some of the accomplishments of the conservation movement in the area of soil and water resources. (Murphy-Rutgers)

### 1226-A2, A3, A5, C2

**PHOSPHORUS AND WATER POLLUTION,**
Agricultural Research Service, Beltsville, Md. Soils Lab.
Alan W. Taylor.
Journal of Soil and Water Conservation, p 228-231, November-December 1967. 4 tab, 26 ref.

Descriptors: *Phosphorus, *Groundwater, *Water pollution sources, Sewage effluents, Eutrophication, Irrigation, Water pollution control, Water chemistry.
Identifiers: Manure, Feedlots, Phosphorus sources, Agricultural fertilizers.

Phosphorus, an important nutrient in natural water, will stimulate excess growth at 0.05 ppm. It is quickly converted to insoluble form in soil and strong sorbtion by soil particles almost completely immobilize it. Pollution from groundwater phosphorus is therefore minimal even though irrigation drainage may cause phosphorus concentration of .08 ppm in groundwater. Eroding topsoils can contribute phosphorus to natural water. Unlike spasmodic erosion flow, manure in stockyards and manure piles supply a steady flow of relatively high phosphorus concentration in available form. Phosphorus pollution from feedlots is significant because concentration of output. Measuring total phosphorus concentration in a water body does not indicate phosphorus available for growth, which is a small fraction of the total. Continuous monitoring of total and available phosphorus concentrations are necessary to assess nutrient sources. One pound of phosphorus dissolved in one acre-foot of water yields a concentration of 0.03 ppm. Phosphorus contamination from sewage effluent is significant, based on a per capita consumption of 2.5 lbs of phosphorus. (Bannerman-Wisconsin)

### 1227-A2,A4,A5,A6,B1,B4,C1, C2,C3,D3,E1,F2,F4

**AGRICULTURAL (LIVESTOCK) WASTES (LITERATURE REVIEW),**
Water Pollution Control Federation, Washington, D.C.
J. R. Miner.
Journal of the Water Pollution Control Federation, Vol 42, No 6, p 1171-1179, June 1970. 59 ref.

Descriptors: *Agriculture, *Industrial wastes, *Waste water treatment, Odors, Cattle, Crops, Biological treatment, Dairy industry, Poultry.
Identifiers: Manure, Feed lots.

Recent literature concerning agricultural waste disposal is reviewed. The problems associated with water pollution control related to cattle feed lot runoff were discussed in relation to the characteristics, handling, treatment, utilization, disposal and odor problems of livestock manure. A review of research pertaining to swine waste management includes discussions of manure properties, application to cropland, treatment technology, alternatives for disposal or utilization, and gases and odors related to manure storage. The production, value, use, and disposal of poultry manure is also included. The value of poultry manure as a fertilizer for specific crops is discussed. A great deal of study has been made on the gases and odors evolved from manure decomposition and a court case is sited in which an award of $36,000 was made due to water pollution and odors. Some wastes which are characterized are from steer, sheep, poultry, and storm runoff from a variety of cropland. A great deal of study was done on cattle feed lot wastes and various methods of treatment. The application of partly treated livestock wastes to cropland has been of growing interest. The largest problem occurring with this type of disposal is the contamination of the groundwater by nitrogen mostly in the form of nitrates. A variety of biological treatment processes were studied including lagoon, aerated lagoons, extended aeration, anaerobic digestion, and aerobic digestion. (Hancuff-Texas)

### 1228-A2, A3, B1, B2, D3, E2, F4

**ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES,**
Cornell Univ., Ithaca, N.Y. Dept. of Civil and Agricultural Engineering.
Raymond C. Loehr.
Journal Water Pollution Control Federation, Vol 43, No 4, p 668-678, 2 fig, 2 tab, 10 ref.

Descriptors: *Farm wastes, *Disposal, *Treatment, *Systems analysis, Runoff, Pollutant, Nutrients, Aerobic treatment, Anaerobic digestion, Dentrification, Nitrification, Effluents, Legal aspects, Waste water treatment, Waste disposal.
Identifiers: Options, Land disposal, Oxidation ditch, Pollutional characteristics alternatives.

The various systems for treating wastes from enclosed confined animal production operations are discussed. There is no one process or waste management system that will be adequate for all animal production operations. Aeration systems such as oxidation ditches are gaining acceptance for waste handling and treatment. It is unlikely that current liquid waste treatment systems for treating concentrated animal waste water will produce effluents that can be discharged to surface water. Land disposal is an integral part of feasible animal waste treatment systems. (Christenbury-Iowa State)

### 1229-C2, C3, D3

**ANAEROBIC LAGOON TREATMENT OF MILKING-PARLOR WASTES,**
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Raymond C. Loehr, and John A. Ruf.
Journal of the Water Pollution Control Federation, Vol 40, No 1, p 83-94, Jan 1968. 5 fig, 4 tab, 14 ref.

Descriptors: *Anaerobic conditions, *Industrial wastes, *Lagoons, Dairy industry, Animals, Biochemical oxygen demand, Coliforms, Efficiencies, Sewage treatment, Sludge, *Waste water

treatment.
Identifiers: *Dairy cattle, *Field study, Milking parlor, Waste characteristics.

A field study of an 80-cow milking parlor and its waste treatment facilities determined that the average flow and BOD5 of the milking parlor waste were 760 gpd (2870 l/d) and 1030 mg/l. The flow varied considerably through the day. The first cell was loaded at 9 lbs BOD5/d/1000 cuft (144 g BOD5/d/cu.m). The summer BOD reduction was 85% while during the winter it was only 70%. The BOD5 of the supernatant from the second cell during the summer ranged from 50 to 100 mg/l. Removal of solids from the lagoons during cold weather adversely influenced the performance of the lagoons. Solids assumulated in the first cell during winter and were degraded during spring. Coliform reductions in the system exceeded 99%. (Aguirre-Texas)

### 1230-B2, D3, F4

**LAGOONS AND OXIDATION PONDS (Literature Review),**
W. C. Boyle.
Journal of the Water Pollution Control Federation, Vol 42, No 6, p 910-916, June 1970. 39 ref.

Descriptors: *Waste water treatment, *Lagoons, *Ponds, Oxidation, Biological treatment, Sewage treatment, Aeration, Temperature, Industrial wastes, Nutrients, Coliform, Efficiency, Poultry, Tertiary treatment.

A review of the 1969 literature on lagoons and oxidation ponds is presented. The review includes discussion of principles of aerated lagoon design. A pilot plant study to treat box-board white water and paper-board mill waste waters is outlined. Discussion of several full scale aerated lagoons is presented and includes the design and cost of treatment. A variety of industrial wastes are treated through pond and lagoons: Kraft mill wastes, pulp and paper mill wastes, refinery and chemical wastes, poultry wastes, hog slaughter house wastes, animal wastes, dairy manure wastes and phenolic wastes. Data are presented on the design, power requirements, organic loadings, efficiencies, effects of temperature, aeration requirements, nutrient requirements, coliform and pathogen removals, and influence of detergents. The use of ponds as tertiary process is also discussed for a variety of wastewaters. (Hancuff-Texas)

### 1231-A4, C2

**POLLUTION AND EUTROPHICATION PROBLEMS OF GREAT SOUTH BAY, LONG ISLAND, NEW YORK,**
New York State Dept. of Conservation, Ronkonkoma.
Jack Foehrenbach.
J Water Pollut Contr Federation, Vol 41, No 8, Part 1, p 1456-1466, Aug 1969. 11 p, 4 fig, 1 tab, 16 ref.

Descriptors: *Eutrophication, *Bays, *Farm wastes, Poultry, Water pollution sources, Water pollution effects, Dissolved oxygen, Oxygen demand, Streamflow, Sport fishing, Commercial fishing, Recreation, Ecology, Economics, Fisheries, Pesticides, Waste water disposal.
Identifiers: *Great South Bay, Long Island (NY).

Great South Bay is located midway between New York City and Montauk Point. Each year sport fisheries gross $4,539,000. In addition, 53,400 lb of finfish ($12,000) and 4,792,000 lb of shellfish ($4,250,000) are harvested. Because of poor recirculation and small inflow of tidal waters, the creek flows of 24 million cu ft/day and groundwater flows of 28 million cu ft/day are helping to increase the nutrient content of the 92-sq mile bay, much of which is less than 8 ft deep. Although the bay has a large assimilative capacity for some forms of pollution, it is reaching a point where additional loads will affect adversely its ecology, economic, and recreational value. (Knapp-USGS)

### 1232-C1, C2, C3

**WASTE WATER FROM SIMIAN PRIMATE FACILITIES,**
Tulane Univ., Covington, La. Delta Regional Primate Research Center.
E. W. Fritschi, and F. W. Macdonald.
Journal Water Pollution Control Federation, Vol 43, No 5, May 1971, p 883-889.

Descriptors: *Laboratory animals, *Waste water treatment, Design criteria, Sampling, Analytical techniques, Evaporation, Biological oxygen demand, Urine, Coliforms, Pathogenic bacteria, Animal parasites, Disinfection, Chlorination, Louisiana, *Treatment facilities.
Identifiers: *Primates, *Bacteriological analyses, Feces.

Water and waste water balances were performed on the Delta Regional Primate Research Center in Covington, Louisiana. Total input of both food and water was measured for selected animals and urine, feces, and vomitus of the animals were also collected and analyzed. Average food consumption was 3.0% of body weight, and an estimated 50% of the food is wastes. Measurement of the BOD of the collected waste materials established primate wastes as being 3 to 6 times higher in BOD than conventional municipal wastes. No correlation of total solids with genera, age, weight, or sex of the animals was discovered. Primate feces were found to be cruder than human feces, also and considerable difficulty in finding a suitable feed for the dilution water. Further study of this phenomenon has been planned. Monitoring of daily water usage revealed a fairly constant flow. There was little daily fluctuation in cage washwater, since the animal population was fairly constant, and all cages had to be washed. Bacteriological analysis revealed a wide variety of organisms including several nonspecific parasites and numerous pathogens. This discovery neccessitated that particular attention be given to chlorination and disinfection. (Lowry-Texas)

### 1233-A2, A3, A4, A5, C2, E2

**LOSSES OF NITROGEN AND PHOSPHORUS FROM AGRICULTURAL LAND,**
Rothamsted Experimental Station, Harpenden (England).
G. W. Cooke, and R. J. B. Williams.
Journal of the Society for Water Treatment and Examination, Vol 19, Part 3, p 253-276, 1970. 7 tab, 34 ref, discussion.

Descriptors: *Water pollution sources, *Nitrogen, *Nitrates, *Agricultural watersheds, Phosphorus, Leaching, Soils, Drainage, Lysimeters, Fertilizers, Rainfall, Model studies, Analytical techniques, Arable land, Grasslands, Clays, Liquid wastes, Livestock, Solubility, Phosphates, Subsoil, Domestic animals, Erosion, Wind erosion, Suspended load.
Identifiers: *United Kingdom, Plowing, Nitrogen losses.

Nitrogen and phosphorus is introduced to water supplies by leaching of drainage water through agricultural land, by liquid wastes from stockyards and surface runoff from saturated or frozen soil, by movement of fine soil particles down profiles and entering drainage systems, and by erosion of surface soil by wind and water. Drainage from well farmed arable land in England contains, on the average, 10 mg/l of nitrate-nitrogen. Nitrate loss in drainage from productive land cannot be prevented because more nitrogen will be mineralized from soil reserves and crop residues by microbial action than arable crops can absorb at times. Drainage passing through permeable subsoils to deep water tables carries nitrate that persists in the water. Soluble phosphate fertilizers leach down soil profiles in podzols developed from Bagshot beds which contain only 1-2% clay in the surface while insoluble phosphates are better retained in these topsoils. Phophorus in manure applied in large amounts annually for 20 years penetrated the subsoil of light land at Woburn, the only example of soluble phosphates in arable soils reaching drainage systems. Watercourse contamination may occur where stock are kept on small areas. (Jones-Wisconsin)

### 1234-A2, B2, C2, C3, D3

**SOME OBSERVATIONS ON THE LIMNOLOGY OF A POND RECEIVING ANIMAL WASTES,**
Oklahoma State Univ., Stillwater. Dept. of Zoology.
Dale W. Toetz.
Proceedings Oklahoma Academy of Science, Vol 51, p 30-35, 1971. 4 fig, 2 tab, 11 ref.

Descriptors: *Oxidation lagoons, *Water pollution effects, *Farm wastes, Oklahoma, Cyanophyta, Chlorella, Ions, Phytoplankton, Nitrates, Nitrogen fixation, Algae, Conductivity, Chlorophyll, Pigments, Dispersion, Runoff.
Identifiers: *Feedlots, Lemna.

A small pond receiving runoff from a hog yard was dominated by a large population of blue-green algae and phytoflagellates during summer and by Chlorella sp during winter. Heavy rainfalls decreased the ionic concentration of water and altered the phytoplankton composition. Occasional concentration of oxygen below 5 mg/l and high ammonia content suggested that the pond is unsuitable for warm-water fish culture. (Wilde-Wisconsin)

### 1235-A2, C2, D3

**BOD DETERMINATIONS ON FEEDLOT RUNOFF,**
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
T. J. McGhee, R. L. Torrens, and R. J. Smaus.
Water and Sewage Works, Vol 119, No 6, June 1972, p 58-61. 7 fig, 1 tab, 20 ref. OWRR A-022-NEB (2).

Descriptors: *Analytical techniques, *Biochemical oxygen demand, *Pollutant identification, *Cattle, Organic matter, Chemical oxygen demand, Oxygen demand, *Feed lots, *Farm wastes.
Identifiers: *Cattle feedlot runoff, Ultimate BOD.

During laboratory studies of the aerobic treatment of feedlot runoff it was observed that significant reductions in the COD of the waste were not reflected in a similar reduction in BOD as determined by the standard 5-day tests. The rate at which the oxygen demand was exerted, the duration of the BOD test necessary to actually measure the pollution effect of such wastes and the general applicability of the standard BOD test to feedlot wastes were investigated. It was concluded that the standard 5-day BOD determination was not an adequate measure of the pollution potential of feedlot runoff as feedlot runoff contained slowly degradable organic materials which would exert a significant oxygen demand over periods in excess of 20 days. The chemical oxygen demand test was a superior technique although it usually yielded higher results than the actual ultimate BOD. (Galwardi-Texas)

### 1236-A5, A8, C2, C3

**MIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT,**
Washington State Univ., Pullman.
James W. Crosby, III, Donald L. Johnstone, and Robert L. Fenton.
Water Resources Research, Vol 7, No 1, p 204-

208, February 1971. 5 p, 5 fig, 11 ref. OWRR Project B-005-WASH (3).

Descriptors: *Path of pollutants, *Glacial drift, *Farm wastes, *Confinement pens, Coliforms, Nitrates, Nutrients, Solutes, Soil water movement, Groundwater, Washington, Water pollution sources, Chlorides, Soil moisture.
Identifiers: FeedlotsCattle), Outwash (Glacial).

A test drilling program was conducted at a dairy in the Spokane Valley, Washington, to determine the effects of feedlot operation on groundwater quality. Coliform bacteria, enterococci, and fecal coliforms were found to disappear within a relatively few feet of the ground surface. Chlorides and nitrates, however, were persistent in depth and may actually reach the groundwater body. The low natural moisture content of the soil, coupled with the apparent high moisture tensions, suggests that soil moisture is not presently moving downward in the system. It is concluded that the downward migration of inorganic chemicals from the feedlot environment must represent an early phase of the operation, which is arrested as organic mattes are formed in near-surface layers. (Knapp-USGS)

### 1237-A4, A6, C1, C2, C3

**POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES,**
Kramer, Chin and Mayo, Seattle, Wash.
Paul B. Liao.
Water and Sewage Works, Vol 117, No 12, p 291-297, 1970. 6 fig, 3 tab, 15 ref.

Descriptors: *Water pollution sources, *Fish hatcheries, *Salmonids, Water requirements, Temperature, Nutrients, Algae, Weeds, Taste, Odor, Pathogenic bacteria, Organic wastes, Solid wastes, Chemicals, Michigan, California, Tubificids, Colorado, Water pollution control, Washington, Chemical oxygen demand, Biochemical oxygen demand, Dissolved oxygen, Hydrogen ion concentration, Ammonia, Nitrates, Phosphates, Suspended load, Dissolved solids, Effluents.
Identifiers: Settleable solids, Hatchery effluents, Parasites, Jordan River (Mich), San Joaquin River (Calif), Rifle Falls (Colo), Fish fecal wastes, Residual food, Green River (Wash), Cowlitz Trout Hatchery (Wash).

Water pollution problems associated with salmonid hatchery operations include nutritional enrichment, algae and weed growth, taste, odor, settleable solids, pathogenic bacteria, parasites, organic matter, chemicals and drugs. Fish fecal wastes and residual food are most serious because they are encountered continuously under normal operating procedures; after field testing, these wastes are classified into organic, nutrient and solid pollutants. The average biochemical oxygen demand (BOD) concentration of hatchery effluents during pond cleaning is several times greater than during normal operation; closely related to BOD, is the dissolved oxygen level. The nutrient pollutants, nitrate and phosphate, are end-products of decomposition of fish food. The hatchery effluent tested may stimulate algal growth and cause algal blooms under certain conditions. The high percentage of suspended and settleable solids indicates that most solids in the cleaning water will be deposited on the stream bottom below the hatchery. Proper feeding would greatly reduce rate of pollutant production. The pollution potential of hatchery cleaning water is comparably to domestic sewage when diluted with infiltration water. Hatchery operating improvements should include proper fish loading techniques, proper feeding procedures, and water supply adjustments. (Jones-Wisconsin)

### 1238-B2, C1, D1, D3, E3

**CLOSED SYSTEM WASTE MANAGEMENT FOR LIVESTOCK,**
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
P. O. Ngoddy, J. O. Harper, R. K. Collins, G. D. Wells, and F. A. Heidar.
Copy available from GPO Sup Doc EP2.10:13040 DKP 06/71, $1.25; microfiche from NTIS as PB-211 022, $0.95. Environmental Protection Agency, Water Pollution Control Research Series, June 1971, 110 p, 28 fig, 21 tab, 19 ref. EPA Program 13040 DKP 06/71.

Descriptors: *Farm wastes, *Water reuse, *Separation techniques, Screens, Suspended solids, Particle size, Sludge, Odor, Economic feasibility, Technical feasibility, Performance, Cattle, Hogs, Analytical techniques, *Waste water treatment.
Identifiers: *Waste management.

A vibrating screen separator has been developed for liquid-solid separation of livestock wastewater. Pilot tests on swine and beef cattle wastewater have shown that the resistant or slowly biodegradable solids are effectively removed on vibrating screens ranging in mesh size from no. 60 to no. 120. Although measurably less efficient than conventional dewatering devices such as centrifuges and vacuum filters, the gravity dewatering vibrating screen separation is better suited to the economic scale of the average livestock operation. The removal of resistant solids from wastewater prior to stabilization substantially improves the performance of biological treatment systems by enhancing the controlling transport and kinetic mechanisms in such processes. Screened solids are odorless, stable, and storable over long periods without an odor nuisance or pollutional problem. The liquid fraction can be partially reclaimed by biodegradation and recycled as transport water. A number of candidate livestock waste management designs integrating the salient features of the study have been proposed. (Lowry-Texas)

### 1239-A5, A8, C2

**DRAIN INSTALLATION FOR NITRATE REDUCTION,**
Southwestern Irrigation Field Station, Brawley, California; Soil Conservation Service, Fresno, California; and U. S. Bureau of Reclamation, Sacramento, respectively.
L. S. Willardson, B. D. Meek, L. E. Grass, G. L. Dickey, and J. W. Bailey.
Paper presented at the 1969 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 9-12, 1969, Paper No. 69-734, 8 p., 2 tab., 2 fig.

Descriptors: *California, *Drains, *Installation, *Nitrates, Permeability, Sumps, *Irrigation, Electrical conductance, Leaching, Percolation, *Groundwater, *Denitrification.
Identifiers: *San Joaquin Valley, Panoche silty clay.

Because farmers remove more nitrates from the soil than they put into it, denitrification or reducing nitrates to nitrogen gas, is sometimes desirable. A field experiment was installed in California's San Joaquin Valley to test submergence of drains as a means of denitrification. The Panoche silty clay area was irrigated four times during the months of July and August. Samples made of the soil showed that the side of the drain oriented toward the ground water source had the highest reading of nitrate content. This indicated that soil denitrification depends ultimately upon saturation from irrigation as well as sufficient presence of organic carbon matter and a shortage of oxygen. Along with soil denitrification, ground water with high nitrate content was also diluted. (Frantz - East Central(

### 1240-A11, A12, C3, F6

**THE PHYSIOLOGY OF THE COLIFORM GROUP,**
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Div. of Water Supply and Pollution Control.
Harold F. Clark, and Paul W. Kabler.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, New York, pp 202-229, 1964. 1 fig, 2 tab, 52 ref, disc.

Descriptors: *Bacteria, *Coliforms, *Pollutants, Sanitary engineering, Water, Foods, Soils, Gases, Hydrogen, Carbon dioxide, Fermentation, Plants, Cattle, Grains (Crops), Biochemistry, Microorganisms, Milk, Acid bacteria, Carbohydrates, Physiochemical properties, Animals, Statistical methods, Birds, Human diseases, Sheep, Geographical regions, United States, Inspection, Spores, Hydrogen sulfide, E coli.
Identifiers: *Physiology, *Bacillus coli, Taxonomy, Health, Aerobacter aerogenes, Feces, Glucose, Morphology, Bacterium coli, Bacterium aerogenes, Motility, Coli communis, B lactes-aerogenes, Sucrose, Lactose, Dulcitol, Raffinose, Mannitol, Methyl, Indole, Tryptophan, Ehrlich reaction, Vibrio cholera, Pigs, Types, Acetylmethyl-carbinol, Citrate, Uric acid, Cellobiose, Liquefaction, Eijkman test.

Although the methodologies for distinguishing between the coliform strains of fecal and non-fecal origin are adequate for pollution, the perfect test has not been developed. The gas ratio (Hydrogen:Carbon dioxide) differential test seemed to solve the problem of differentiating the coliform bacteria of fecal origin from those of plant or soil origin but was unadaptable as a routine method. As laboratory procedure, the methyl red test was recommended as of equal value. Since certain assumptions were not valid, its use as a reference procedure was rejected. The property of producing indole from tryptophan has been extensively applied. The indole reaction by coliform bacteria from feces of warm-blooded animals is generally positive in excess of 90 percent, although approximately one-fifth of the coliform bacteria from unpolluted soils can also produce indole. The Voges-Proskauer test, traditionally used as a taxonomic characteristic, is useful in separating fecal from non-fecal coliform group when the data are interpreted statistically. The citrate utilization reaction is useful, on a statistical basis, for separating fecal and non-fecal types. The tests, methyl red, indole, Voges-Proskauer, citrate, none entirely satisfactory individually, combined (IMVIC test), yielded the best classification. The elevated temperature test was superior to other procedures in simplicity. (Jones-Wisc)

### 1241-C3, F6

**PHYSIOLOGY OF THE RUMEN PROTOZOA,**
Agricultural Research Center, Beltsville, Md. Animal Husbandry Research Div.
J. Gutierrez, and R. E. Davis.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, pp 394-404, 1964. 2 fig, 1 tab, 17 ref, disc.

Descriptors: *Ruminants, *Protozoa, *Bacteria, Cattle, Reproduction, Metabolism, Amino acids, Tracers, Proteins, Chromatography, Fermentation, Digestion, Lipids, Manometers, Streptococcus, Alfalfa.
Identifiers: *Rumen, *Physiology, Casein, Isotrichs, Holotrichs, Paramecium, Isotricha prostoma, Isotricha intestinalis, Dasytricha, Diplodinium ecaudatum, Entodinium simplex, Ophryoscolex caudatus, Starch, Epidinium ecaudatum, Diplococcus, Peptostreptococcus.

Some functions carried out by rumen protozoa are: producing fatty acids which are absorbed yielding energy to the host; aiding digestion of ingested substrates--starch, cellulose, and bacteria; serving as a source of protein for the host. Tracer experiments showed they are able to incorporate amino acids. As a source of protein, the protozoa furnished 20%

of the host requirement. Protozoan protein was found to have a higher nutritive value than bacterial or yeast protein. Protein contributed to the host was calculated for several protozoa with the cellular nitrogen content experiments. Paper chromatography of acid-hydrolyzed suspensions has indicated a long list of amino acids contained in the protozoal protein, available to the host. The quantitative experiments on ammonia production from casein show that, for some rumen protozoa, ammonia can be an important product of nitrogen metabolism. They contribute to lipid metabolism of the rumen. All the common genera of protozoa are bacteria feeders. Protozoan requirements for growth were studied by in vitro culture work. Of the several media developed, ground rice starch, alfalfa, and Streptococcus bovis, made a successful medium. Attempts to grow the protozoa without living bacteria have been unsuccessful.
(Jones- Wisc)

### 1242-A8, C1, C3, E2

**THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS,**
California Univ., Davis, Dept. of Civil Engineering.
R. B. Krone.
Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, p 75-104, 1968. 30 p, 2 fig, 55 ref.

Descriptors: *Water reuse, *Pathogenic bacteria, *Viruses, *Groundwater movement, Municipal wastes, Irrigation water, Artificial recharge, Filtration, Sorption, Infiltration, Percolation, Soil disposal fields, Soil contamination, Soil physical properties.
Identifiers: Municipal waste recharge.

The movement of pathogenic organisms through soils recharged with contaminated water is discussed. Pathogens have a wide variety of physical and biological characteristics, including wide ranges of size, shape, surface properties, and die-away rates. The processes of filtration by soil include straining at the soil surface, straining at intergrain contacts, sedimentation, and sorption by soil particles. Straining of pathogens at the soil surface and sorption of viruses near the soil surface is desirable because it limits travel of pathogens most, and it is subject to wide variations in temperature and moisture, and it will assure aerobic conditions. A soil containing clay should therefore be used for irrigation with treated sewage. Wide experience in irrigation with treated sewage indicates that it is safe provided that at least primary treatment is used, and provided that the crops are not consumed directly by humans. Secondary treatment and chlorination is recommended for aesthetic reasons. (Knapp-USGS)

### 1243-A2, A3, A4, F4

**THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,**
Kansas Univ., Lawrence, Kans.
Raymond C. Loehr.
Proceedings of the Third Annual American Water Resources Conference, 1967, pp 314-324, 11 p, 2 fig, 2 tab, 28 ref.

Descriptors: *Animal wastes, Wastes, Water pollution sources, Cattle, Fishkill, Waste disposal, Kansas, Runoff, Nitrogen, Drainage, Diseases, Water pollution effects.
Identifiers: Animal production trends, Animal confinement trends, Organic pollution, Inorganic pollution.

Until recently animal wastes have been considered as part of the 'natural' pollution of a region. Animal production is changing from small farm operations into large scale industrial enterprises. There is an increasing trend to confine animals within small areas to produce the greatest weight gain in the shortest period of time. Under such conditions, it is not possible for these animals to drop their wastes on pastures where the wastes can be absorbed by nature without adversely affecting the environment. Animal wastes have been shown to be a major source of surface water pollution. This paper mentions cases of pollution that have been caused by animal wastes and animal production operations. It discusses the trend toward confinement feeding operations and the magnitude of the problem in the future. It also demonstrates the need to consider animal wastes when developing or protecting water resources. (Seneca-Rutgers)

### 1244-A12, B2, C3, E2

**SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS,**
Colorado Univ., Denver. Dept. of Microbiology.
Stuart G. Dunlop.
Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, pp 107-121, 1968. 15 p, 1 tab, 62 ref.

Descriptors: *Hazards, *Irrigation water, *Reclaimed water, *Municipal wastes, Pathogenic bacteria, Viruses, Parasitism, Waste treatment, Environmental sanitation.
Identifiers: Waste water irrigation.

The hazards to health caused by irrigation with reclaimed municipal waste water are surveyed. No disease outbreaks have been traced to irrigation with properly treated and disinfected sewage, but many epidemics have been caused by irrigation with improperly treated wastes. The same standards are recommended for effluents as for any other irrigation water. Survival times of pathogenic organisms in water are discussed and tabulated. (Knapp-USGS)

### 1245-A2, B2, B4, C2, C3

**EFFECTS OF FEEDLOT RUNOFF ON WATER QUALITY OF IMPOUNDMENTS,**
Robert S. Kerr Water Research Center, Ada, Okla.
W. R. Duffer, R. D. Kreis, and C. C. Harlin, Jr.
Water Pollution Control Research Series, Environmental Protection Agency July 1971, 53 p, 13 fig, 7 tab, 9 ref, append. EPA Program 16080 GGP 07171.

Descriptors: Reservoirs, *Fishkill, *Ammonia, *Dissolved oxygen, Runoff, *Feedlots, Organic wastes, Nutrients, Phytoplankton, Light penetration, Zooplankton, Bethos, *Farm wastes, Water pollution sources, Cattle.
Identifiers: Solids concentrations.

Effects of rainfall runoff from a beef cattle feedlot on the water quality of a small impoundment were determined. Changes in chemical concentration of impounded water and changes in the community structure of aquatic organisms were measured and related to the amount and composition of feedlot runoff received. Water quality changes were also monitored in a nearby reservoir which received no feedlot runoff to serve as a control. Rainfall from feedlots was retained in collection ponds and pumped into the impoundment over a relatively short period of time, creating in effect a 'slug' discharge conditon. Changes in chemical concentration or population structure of organisms were not apparent for discharges of about one-part feedlot runoff to 40 parts receiving water. Runoff discharges for two pumping periods with each contributing one-fourth of the volume of the receiving water were shown to degrade water quality in the impoundment. Several significant chemical and biological changes occurred. The concentration of salts, solids, oxygen-demanding organic compounds and nutrients increased. Population levels decreased for organisms having negative tolerances for low dissolved oxygen and high ammonia concentrations. The most dramatic reduction in the biological community was the suffocation of about 90% of the game fish in the impoundment. Reduction in population levels of 'stressed' organisms was followed by increased productivity of phototropes in response to higher nutrient concentrations. (Dorland-Iowa State)

### 1246-A1, B1, F2

**FEEDLOT WASTE MANAGEMENT.**
Missouri River Basin Animal Waste Management, Kansas City, Mo. Pilot (Steering) Task Group.

Environmental Protection Agency, June 1971. 45 p, 2 fig.

Descriptors: *Water pollution control, Confinement pens, Cattle, Pollutants, Non-structural alternatives, Path of pollutants, Water law, Legislation, Regulation, Farm wastes, Livestock, Management, Financing, Missouri River, River basins.
Identifiers: Technical assistance.

Basic information on the problem of beef cattle feedlot waste management and the pollution arising from these operations is presented in a non-technical manner. The factors that cause feedlots to pollute and the magnitude pollutants may reach are discussed along with some management factors and structural and mechanical means to help control water pollution. Sources of technical and financial assistance in design and layout of control facilities and the water pollution control agencies for the ten Missouri River Basin states are listed. Existing animal waste control regulations are also furnished for these ten states. (EPA abstract)

### 1247-D1, E1, F2

**DISPOSAL OF INDUSTRIAL WASTES.**

Oregon Administrative Rules Compilation, ch 340, secs 43-005 thru 43-025 (1970).

Descriptors: *Oregon, *Industrial wastes, *Waste disposal, *Pollution abatement, Water pollution, Ultimate disposal, Regulation, Administrative agencies, Liquid wastes, Organic wastes, Solid wastes, Pollutants, Waste water disposal, Legislation, Legal aspects, Farm wastes, Confinement pens, Hogs, Cattle, Canneries, Industrial plants, Foods, Poultry, Livestock.

Unless the Department of Environmental Quality provides an exemption, all fruit and vegetable processing plants shall provide efficient facilities to remove all suspended and floating materials from the wastes resulting from canning and freezing processing. All solids retained by a standard twenty mesh screen shall be removed from liquid wastes by screening or other approved method and disposed of in a non-polluting manner. Wastes from slaughterhouses and meat packing plants shall be disposed of in a manner that will prevent direct or indirect entry into public waters. All blood shall be collected and disposed of separately from other wastes. Manure and hog stomach contents shall be collected separately and used as fertilizer, land-fill, or in some other approved manner. All fleshings, grease particles, hair and other solid materials shall be collected by dry cleaning of floors and by screening of wastes. Adequate grease recovery basins shall be installed. Similiar provisions govern the disposal of wastes in poultry killing and packing plants. To prevent water pollution from solid wastes, hog feeding yards and holding pens shall be constructed so that they can and will be dry cleaned before being washed down. (Gallagher-Florida)

### 1248-A2, B1, C2, C3, E2, F4

**LIVESTOCK INDUSTRIES IN TEXAS AS RELATED TO WATER QUALITY, REPORT NUMBER ONE,**

Texas Water Quality Board, Austin.
D. Pittman, and P. Harris.
Texas Water Quality Board, Austin, 1970. 30 p, 5 tab, 10 ref.

Descriptors: *Texas, *Water quality, *Livestock, *Farm wastes, *Waste treatment, *Poultry, Wastes, Solid wastes, Cattle, Hogs, Sheep, Waste disposal, Farm management.

Trends are discussed in animal populations in Texas, management techniques employed by animal producers, and characteristics of animal wastes and treatment methods used. In addition, typical and/or economical animal producing units in Texas are described, with an explanation of current practices used to control water pollution caused by animal wastes. A number of conclusions are made from the material presented. The numbers of beef cattle, sheep and poultry in Texas are increasing. There is a trend to confine animals and feed them for more efficient production. Characteristics of animal wastes are variable making it difficult to determine the pollutional effects of the wastes and to recommend adequate treatment. Biological and chemical changes often occur in wastes from confined feeding areas. Conventional domestic waste treatment systems are as yet not feasibly adaptable to animal wastes. Current animal waste management for controlling runoff from confined feeding areas include the use of diversion terraces, ditches and retention ponds with irrigation facilities for dewatering the ponds. (Poertner)

## 1249-A4, A12, F2

### AGRICULTURAL AND RELATED WASTES CONTROL.

Regulations No. 28-18-1 thru 28-18-4, Kansas Department of Health, Environmental Health Services, Topeka, Kansas, May, 1967. 4 p.

Descriptors: *Waste disposal, *Kansas, *Domestic animals, *Water pollution control, Water pollution, State governments, State jurisdiction, Administration, Regulation, Administrative agencies, Legal aspects, Permits, Standards, Water pollution sources, Treatment facilities, Public health, Cattle, Sheep, Farm wastes, Farms.

The operator of any newly proposed or existing confined feeding operation must register with the department of health. All application forms shall contain information regarding general features of topography, drainage course, and identification of ultimate primary receiving streams. If a confined feeding operation constitutes a water pollution hazard the operator must provide water pollution control facilities which shall be constructed in accordance with plans and specifications approved by the department. Such water pollution control facilities shall not be placed in use until a permit has been issued by the board of health. If a water pollution control facility's permit is revoked, the owner or operator of the confined feeding operation involved shall be allowed to finish feeding existing animals, but may not place any more animals in the feeding area until the minimal requirements are met. The regulation establishes the minimum requirements for water pollution control facilities used for the confined feeding of cattle, swine, sheep, and other animals. All such facilities must be operated and maintained so as to prevent water pollution and protect the public health and the beneficial uses of the state's waters. (Horwitz-Florida)

## 1250-A5, A8, C2, C3

### DISTRIBUTION OF NITRATES AND OTHER WATER POLLUTANTS UNDER FIELDS AND CORRALS IN THE MIDDLE SOUTH PLATTE VALLEY OF COLORADO,

Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch; and Colorado Agricultural Experiment Station, Fort Collins.
B. A. Stewart, F. G. Viets, Jr., G. L. Hutchinson, W. D. Kemper, and F. E. Clark.
U S Department of Agriculture, Agricultural Research Service, ARS 41-134, December 1967, 206 p. 31 fig, 25 tab, 13 ref.

Descriptors: *Nitrates, *Ammonia, *Water pollution sources, *Cores, Fields, Plants, Alfalfa, Cereal crops, Irrigated land, Colorado, Groundwater, Percolation.
Identifiers: Native grasses, Feedlots, Corrals, South Platte Valley (Colo).

Cores representing nonirrigated fields in native grass, cultivated nonirrigated fields, irrigated fields in alfalfa, irrigated fields in crops other than alfalfa, and corrals were obtained from northeastern Colorado during 1966. Cultivated nonirrigated fields usually contained small accumulations of nitrate below the root zone. Native grass fields, ordinarily, did not show nitrate accumulation in core profiles. Significant quantities of nitrate were found in most cores from irrigated fields with row crops or cereal grains. Alternately, cores from irrigated alfalfa fields generally contained insignificant amounts of nitrate. Amounts of nitrogen as nitrate found under corrals were extremely varied, ranging from almost none to more than 5000 pounds/acre in a 20-foot profile. Evidence disclosed that denitrification was occurring under feedlots, even at several feet below the surface, consequently, much of nitrate under feedlots will probably never reach the water table. Water samples beneath several corrals contained large amounts of organic carbon and ammonia and possessed offensive odor. Bacterial counts under corrals were considerably higher than under other areas, especially at lower depths. These findings indicate some pollution of groundwater by deep percolation is occurring from corrals, but more studies are required before significance and magnitude of this pollution can be assessed. (Keeney-Wisconsin)

## 1251-A4, A7

### AIRBORNE AMMONIA EUTROPHIES LAKES.

Agricultural Research (USDA), Vol. 19, No. 2, p 8-9, August 1970.

Descriptors: *Ammonia, *Eutrophication, *Nitrogen, Algae, Water pollution sources, Colorado, Cattle, Urine, Path of pollutants, Farm wastes.
Identifiers: Feedlots.

Ammonia traps and rain gages were installed at five sites and in two control areas in Colorado to determine the rate at which ammonia is adsorbed directly from the air by water surfaces under different conditions of temperature and climate at various distances and directions from cattle feedlots. In one northeast Colorado lake a little over a mile from a large feedlot, the surface adsorbed about 30 pounds of nitrogen as ammonia per acre per year. This amount is sufficient to eutrophy a lake averaging 20 feet in depth to two or three times the concentration needed for algal blooms. Indications are that even small feedlots may release enough ammonia to have an effect on nearby water surface and that airborne ammonia from feedlots may contribute more nitrogen than runoff and deep percolation from the same sources. (Mortland-Battelle)

## 1252-A4, A5, C2, D1, D3

### NITRATE POLLUTION OF WATER,

Illinois State Water Survey, Urbana.
Julius H. Dawes, Thurston E. Larson, and Robert H. Harmeson.
In: Frontiers In Conservation, Proceedings 24th Annual Meeting Soil Conservation Society of America, August 10-13, 1969, Colorado State University, Fort Collins, p 94-102, 1970. 9 p, 8 fig, 6 tab, 6 ref.

Descriptors: *Water pollution sources, *Groundwater, *Surface waters, *Nitrogen compounds, Illinois, Hydrologic cycle, Fertilizers, Industrial wastes, Decomposing organic matter, Organic wastes, Domestic wastes, Livestock, Precipitation (Atmospheric), Water quality, Chemical analysis, Soils, Soil water, Seepage, Sorption, Crops, Nitrates.

Nitrogen levels in surface waters that exceed established standards are evidence of mans intrusion in the environment and the cause of deterioration in water quality. Thirty-nine million tons of chemical fertilizers were applied in the United States in 1967, of which approximately 6 million tons was nitrogen. In Illinois about 25% of all water samples from wells 50 feet deep or less have been found to contain an excessive concentration of nitrate, that is, above the 45 milligrams per liter level. The sources of nitrogen in Illinois surface and subsurface waters are varied and often difficult to identify. Known sources of pollution include precipitation, human wastes, crop residues, decomposing animal or plant tissue, industrial wastes, and nitrogen fertilizer. At the present time there is no known practical and economical way of recovering these excess nitrates. Membrane techniques and biological methods both have potential for preventing pollution of water by nutrients, salts, and minerals, whether the source is fertilizer, irrigation water, sewage, or industrial wastes.
(Woodard-USGS)

## 1253-A5, B2, C1, C2, D3, E3, F1

### WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT,

Kansas Univ., Lawrence.
Ross E McKinney, and Robert Bella.
Contrib No 24, Kans Water Resources Res Inst Proj Completion Rep. 1968. 88 p, 21 fig, 12 tab, 13 ref. OWRR Project A-011-KAN.

Descriptors: *Farm wastes, *Waste treatment, *Aerobic treatment, *Hogs, Farm lagoons, Settling basins, Soil disposal fields, Sewage treatment, Disposal, Environmental engineering, Sludge disposal, Waste storage.
Identifiers: Hog farm wastes.

Treatment methods for the wastes of confined hogs are examined. Confined-animal wastes are a major pollution problem. There are about 55 million hogs in the U.S., and their wastes are largely untreated When they occupy a large area, foraging for food, this is no problem, but under confinement the problem is similar to that of municipal waste disposal. A facility consisting of an aerobic biological treatment system for 10,000 hogs was studied. An important consideration was odor control because of a nearby metropolitan area. Recycled effluent was used for raw-waste input dilution, and paddle-wheel aerators were selected for high oxygen transfer efficiency and low operating cost. Each building had an aeration ditch under its slotted floor for aerobic processing, and final disposal was by a 2-stage infiltration pond system and field spreading of solids. Measurements were made of DO, BOD, COD, pH, suspended solids, N, and trace metals. Chemical analysis results and cost data are tabulated. Operation expense is about 1-2 cents per hog per day. Stream pollution is prevented or greatly reduced and odors are no problem. (Knapo-USGS)

## 1254-C3

### ISOLATION OF ANAEROBES.

Academic Press, Inc., New York, N.Y. 1971. D.A. Shapton and R. G. Board, editors. 257 p.

Descriptors: *Isolation, *Cultures, Soil bacteria, Protozoa, Fungi, Photosynthetic bacteia, Sulfur bacteria, Nitrogen fixing bacteria, Soil microorganisms, Clostridium, Enteric bacteria, Bioassay, Animal wastes, Poultry, Ruminants, Sediments, Foods, Soils.
Identifiers: *Enumration, Enrichment, Cellulolytic bacteria, Lipolytic bacteria, Bacteriodaceae, Biological samples, Bacteroides fragilis, Sphaerophorus, Fusiformis, Zymomonas anaerobia, Fusobacteria, Spirochaetes, Microaerophilic vibrio, Anaerobes, Culture media, Feces, Tissue, Entodinium caudatum, Entodinium simplex, Epidinium ecaudatum caudatum, Polyplastron multivesiculatum, Actinomyces, Leptotrichia, Veillonella.

Methods are presented for culturing, isolating, and enumerating anaerobic microorganisms including Clostridia; enteric bacteria; anaerobic bacteria of man, ruminants, poultry, and horses; photosynthetic bacteria; nitrogen-fixing bacteria; sulfur bacteria; protozoa; and fungi. The methods are used for isolating the bacteria from animal tissue, food, feces, soil, intestines, bovine rumen and the human mouth. (Holoman-Battelle)

### 1255-A4, A11, B1, F4

**DISEASES OF FEEDLOT CATTLE,**
R. Jensen, and D. R. Mackey.
Lea and Febiger: Philadelphia, Pa. 1971. 2nd Edition. 377 p.
Identifiers: *Animal diseases, Cattle, Feed lots, Farm wastes, Water pollution sources.

Emphasizing the diseases of feedlot cattle, this book brings together current literature pertinent to an expanding branch of veterinary medicine. Each disease is considered under the headings of definition, occurrence, etiology and pathogenesis, clinical signs, postmorten lesions, prevention and treatment. Autopsy findings are presented exactly as practitioners and students should have them to make accurate diagnoses. Carefully selected postmortem and antemortem photographs augment the test. In addition to individual treatments, mass treatments for numerous cattle in a specific lot are described. Many of the newer diseases are discussed, with advice on vaccinations and preventive methods found helpful in their control. Full consideration is given to the causes, clinical signs, diagnosis and treatment of viral bovine rhinotracheitis and other respiratory diseases which cause such serious losses to the cattle fattening industry. All chapters are revised for this edition, with up-to-date information added on treatments, including the use of thiamine hydrochloride for polioencephalomalacia. New preventive measures are discussed, such as the vaccine for the protection against shipping fever. The economic importance of each disease is given and the problems of feedlot pollution of water, soil and air are considered fully. New chapters cover such important topics as preconditioning, adapting cattle to the change in diet from roughage to concentrate, bluetongue, necrotic posthitis and high mountain disease. A subject index is included.--Copyright 1972, Biological Abstracts, Inc.

### 1256-A5, A8, C2, F6

**MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS,**
University of Minnesota, Minneapolis, Department of Agricultural Engineering.
P. Goodrich.
PH D Thesis, Purdue University, Department of Agricultural Engineering, 1970, 135 p., 3 tab., 57 fig., 49 ref.

Descriptors: *Phosphates, Soil contamination, *Saturated soils, Isotherms, Sands, Diffusion, *Adsorption, Clay, *Soil Columns, Radioisotopes, Denitrification, Waste water (pollution), Electromagnetic waves, Instrumentation, Effluents, *Irrigation, *Water pollution, *Waste disposal, Nutrients, Farm wastes, *Monitoring.
Identifiers: *Radioactive tracer solutions, Scintillator, Automatic data collection, Sandy loam, Land disposal, Influent.

A laboratory experiment was carried out using uniform soil columns and radioactive tracer solutions to monitor movement of phosphorus inside soil columns. An electronic data acquisition system was developed to monitor long term study. Results were compared with adsorption models already developed. Simulated high-phosphate irrigation showed the limited capabilities of surface soil in preventing ground water pollution. Sand and sand loam soils were tested. Results emphasized the importance of clay minerals in phosphate adsorption. However, soils have a finite capacity for adsorbing phosphate, and contineous flushing as in irrigation may cause the phosphate to move quickly to great depths, thus affecting ground water. Therefore, the design of disposal fields must be considered in order to prevent over-accumulation of phosphorus in soil columns. (Frantz - East Central).

### 1257-B1, F1, F4

**EVALUATION OF BEEF CATTLE FEEDLOT WASTE MANAGEMENT ALTERNATIVES,**
Oklahoma Agricultural Experiment Station, Stillwater.
A. F. Butchbaker, J. E. Garton, G. W. A.
Mahoney, and M. D. Paine.
Environmental Protection Agency.
Water Pollution Control Research Series, November 1971. 322 p, 61 fig, 51 tab, 94 ref. EPA Program 13040 FXG 11/71.

Descriptors: *Farm wastes, *Feedlots, *Management, *Agricultural runoff, Ultimate disposal, Cost analysis, Water pollution control, Cattle, Operation and maintenance, Separation techniques, Oxidation lagoons, Transportation, *Waste water treatment, *Waste treatment.
Identifiers: *Feedlot waste management alternatives.

Alternative beef waste management systems were examined to determine minimum cost systems for effective waste disposal. Design and cost information was obtained from feedlot visits and the literature. A computer program was developed for use with a Conversational Programming System (CPS) for calculating the sizes of equipment and facilities and for estimating the facility and machinery operating and investment costs. For open feedlots, two waste management systems, solid and runoff-carried, were considered. The total system investment cost for a 20,000 head unpaved feedlot with pollution control was approximately $420,000 with an operating cost of $0.133 per animal day (not including feed mill and storage, office or land costs). The pen facilities were about 65% of the total investment cost, the runoff control system about 10% and the solids handling about 25%. Confinement buildings with slotted floors using slurry handling methods or with solid floors using solid handling methods offer a high potential for completely controlling the animal waste and abating pollution. A promising system for near optimum pollution control is a cable scraper system underneath a slotted floor for daily removal and disposal of the wastes. A manure irrigation system costs about one-half as much as mechanically conveying the slurry to the fields. In semi-arid areas, evaporation lagoons offer another ultimate disposal alternative. (Lowry-Texas)

### 1258-A4, A12, C3

**RECOVERY OF BACTERIAL PATHOGENS FROM HIGH QUALITY SURFACE WATER,**
Colorado State Univ., Fort Collins.
J. F. Fair, and S. M. Morrison.
Water Resources Res, Vol 3, No 3, pp 799-803, 1967. 5 p, 2 tab, 5 ref. Grant WP-00679.

Descriptors: *Water quality, *Aquatic microbiology, *Pathogenic bacteria, *Wildlife, *Livestock, Salmonella, Potable water.
Identifiers: Arizona group pathoginic organisms.

An investigation of the presence of enteric disease producing bacteria in a high quality mountain stream in Colorado yielded 11 isolants of members of the genus Salmonella and 51 isolants of organisms belonging to the Arizona group. An improved method for the recovery of these organisms from high quality water was developed and used successfully. The presence of these potentially pathogenic bacteria, which appeared to be the result of contamination by wild or domestic animals, may be a potential hazard to public health.

### 1259-A5, A6, A10, A13, B2 D3

**WASTE STABILIZATION PONDS FOR AGRICULTURAL WASTES,**
California Univ., Davis; and Kansas State Univ., Manhattan.
Samuel A. Hart, and Marvin E. Turnet.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 457-463, 2 tab, 6 ref.

Descriptors: *Waste treatment, *Stabilization, *Ponds, *Design criteria, *Anaerobic digestion, Sludge, Disposal, Odors, Mosquitoes, Insect control, Subsurface waters, Infiltration, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD).
Identifiers: *Agricultural wastes, *Manure stabilization pond, *Livestock manure characteristics, *Pond loading rates, *Pond appearance and location, Sludge digestion, Sludge disposal.

In contrast to sewage and other wastewater stabilization ponds, manure disposal ponds are expected to accept very large amounts of organic solid matter, often with scarcely enough water to get the wastes into the pond. The objective is stabilization and disposal of organic matter rather than water purification; effluent is lacking; make-up water is often needed. Biochemical oxygen demand (BOD) loading ranges up to 1200 lbs/acre/day; anaerobic conditions predominate; and are functionally comparable to open unheated sludge lagoons or conventional sludge digesters. Research during the past 5 years confirms dependence on anaerobic processes to stabilize agricultural wastes. Major design criteria are: (1) control odors, (2) control fly and mosquito production, (3) prevent infiltration of pond liquor to subsurface natural waters, (4) proper siting for aesthetic purposes. Other important design considerations relate to: volume and depth criteria, summer sludge upwelling requirements and winter sludge submersion requirements, manure inlet location, sludge build-up rates and removal, pond water levels, effluent runoff control, pond geometry and, plant and insect control. (D'Arezzo-Texas)

### 1260-A4, A5, A9, D2, D3, E2, F4

**NONPOINT RURAL SOURCES OF WATER POLLUTION,**
S. Lin.
ISWS-72-CIR111, Illinois State Water Survey, Urbana, Department of Registration and Education, 1972, 36 p., 20 tab., 4 fig., 84 ref.

Descriptors: *Water pollution, *Rural areas, Fertilizers, Pesticides, Erosion, Sediment, Farm wastes, Nitrogen, Phosphorus, Runoff, Waste treatment, Waste disposal, Illinois.
Identifiers: *DDT, Soil conservation methods.

A literature survey of major sources of rural water pollution was made. Major pollutants are fertilizers, pesticides, erosion and sediment, and animal wastes. In commercial fertilizers, nitrogen and phosphorus pose the greatest pollution threat.. Pesticides are only slightly soluble in water and then only five percent of that applied reaches waterways. Soil erosion and sediment, which carry the greatest threat for pollution, can be minimized by contour farming, terracing, cover crops and/or crop rotation. Farm animal waste treatment may be accomplished by aerobic digestion, lagoons, composting, land disposal, or chemical treatment, however, these are systems used in domestic waste treatment and the same degree of success had not been achieved with animal waste. (Marquard - East Central).

### 1261-B1, F1, F6

### INTERREGIONAL COMPETITION IN THE CATTLE FEEDING ECONOMY WITH SPECIAL EMPHASIS ON ECONOMIES OF SIZE,

Texas A & M University, College Station, Department of Agricultural Economics and Rural Sociology.
R. A. Dietrich.
Interregional Competition in the Cattle Feeding Economy with Special Emphasis on Economies of Size, B-1115, Texas Agricultural Experiment Station (Project No. HM-2489) in cooperation with the U.S.D.A., September, 1971, 55 p., 39 tab., 8 fig.

Descriptors: *Feed lots, *Cattle, *Economics, *Size.
Identifiers: Regional production characteristics, Transportation rates, Least-cost shipment routes, Feed grains.

This study utilizes a multi-dimensional transshipment model to determine the least cost location and optimum levels of cattle feeding and fed-cattle slaughter among 27 specified regions in the 48 contiguous states to satisfy the demand for fed beef. Data showed that readily available supplies of feed grain and feeder cattle and economies of size in feedlot operations are of major importance in determining the optimum location and levels of cattle feeding. Models were also developed to systematically measure the effects of specified changes in regional feedlot size and projected 1975 regional feedlot sizes on the optimum regional location and levels of cattle feeding and slaughter. In addition, the study shows the least-cost shipment routes for feeder cattle, feed grains, fed slaughter cattle, and dressed fed beef to meet the demand requirements in the various sectors of the cattle feeding-fed-beef economy. (Wetherill - East Central).

### 1262-B1, B4, D3, F6

### CLIMATE AND THE SELECTION OF A BEEF WASTE MANAGEMENT SYSTEM,

Oklahoma State University, Stillwater, Agricultural Engineering Department.
A. F. Butchbaker, G. W. A. Mahoney, J. E. Garton.
Paper presented at 65th Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No, 72-410, 35 p., 1 tab., 10 fig., 28 ref.

Descriptors: *Climates, *Feed lots, *Waste disposal, *Cattle, Temperature, Moisture deficit, Aerated lagoons, Management.
Identifiers: *Site selection, *Beef housing system, Anaerobic lagoons.

Climate classifications are defined and climate effects on animals and waste management systems are discussed. As a result, two climatological models for beef housing and waste management were developed to serve as a basis for delineating areas that require different beef housing and waste management practices. One used January and July temperature limits for beef production and moisture deficit. Beef housing and waste management systems were classified by climatological areas. Essentially, more humid areas require more complete housing and waste management systems. Areas of high moisture deficit are optimum for open feedlots. Areas above 60°F require sunshades, and year-around disposal of wastes on croplands can be achieved. Areas below 45°F require a higher degree of housing and storage facilities for winter wastes. (Marquard - East Central).

### 1263-A11, B5, C2

### CHROMIC OXIDE AND CRUDE PROTEIN EXCRETION IN THE BOVINE AS INFLUENCED BY WATER RESTRICTION,

University of Kentucky, Lexington.
D. L. Cross, J. A. Boling, and N. W. Bradley.
Journal of Animal Science, Vol. 36, No. 5, p. 982-985, May, 1973, 4 tab., 2 fig., 13 ref.

Descriptors: *Farm wastes, *Proteins, *Cattle, Metabolism.
Identifiers: *Chromic oxide,* Water restriction, Dry matter digestibility, Fecal dry matter.

Twelve yearling Angus steers were assigned to two periods and two treatments in an experiment designed to study the effect of water restriction on the excretion of chromic oxide and crude protein. Each steer was confined to a metabolism crate and received 4 kg. of a ration plus water free choice or 80% free choice daily. During each period, fecal samples were taken at 2 hour intervals for 48 hours followed by a 7 day total collection of feces. The percent recovery of chromic oxide averaged 103.1 and 102.3 respectively for the steers offered water free choice or 80% of free choice. There was no difference in the digestion of crude protein between treatments. There was an increase in dry matter digestibility and chromic oxide concentration in fecal dry matter when water was restricted. Water restriction did not affect crude protein concentration of fecal dry matter, These data suggest that water restriction has little effect on the excretion of chromic oxide and crude protein. (Marquard East Central).

### 1264-A6, B1, C1, C3, D2, D3

### PRINCIPLES OF FEEDLOT ODOR CONTROL,

Texas A & M University, Texas Agricultural Extension Service, Department of Agricultural Engineering.
J. M. Sweeten.
Texas A & M University, Texas Agricultural Extension Service, Department of Agricultural Engineering, December 1, 1972, 8 p., 4 ref.

Descriptors: *Air pollution, *Feed lots, *Farm wastes, Aerobic bacteria, Moisture contents, Temperature, Waste treatment, Poultry, Lagoons, Waste disposal.
Identifiers: *Odor control, Odor measurement, Odor intensity, Odor quality.

The major obstacle to developing effective odor control techniques, writing guidelines for feedlot odor control, and litigation of feedlot odor cases is the lack of suitable quantitative methods for measuring the intensity and quality of odors. Measuring odor intensity is usually done by diluting with odor-free water; however, measurement of odor quality is difficult because of the lack of an accepted standard. The physical variables which affect the generation of malodors from manure are temperature and moisture content. Experiments with poultry manure have shown that manure odor intensities are proportional to moisture content. This has suggested two approaches to odor control of feedlots — (1) maintenance of aerobic conditions for decomposition, and (2) the chemical treatment of manure. Judicious site selection of feedlots with respect to surrounding land use patterns and climatic factors is a third alternative which has had some success. (Dudley - East Central).

### 1265-A4, A5, B1, B4, D2, D3, E3, F2

### WASTE MANAGEMENT RESEARCH, PROCEEDINGS OF THE 1972 CORNELL AGRICULTURAL WASTE MANAGEMENT CONFERENCE

Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, 580 p. 160 fig, 151 tab, 265 ref.

Descriptors: Farm wastes, *Waste disposal *Agriculture, *Environment, *Pollutants, *Waste treatment, *Waste storage, *Legal aspects, *Regulations, *Cattle, *Feed lots, Poultry, Hogs, Agricultural runoff, Recycling, Pollution abatement.
Identifiers: *Waste management, Composting, Refeeding wastes, Pyrolysis.

Forty-nine papers were presented at the Cornell Waste Management Conference. These papers present varied aspects of waste management including: (1) legal and legislative regulations, (2) problems and alternatives for handling, treatment, and disposal systems for dairy, hog, beef, and poultry waste, (3) water quality, and (4) utilization of wastes as a feed source. (Marquard-East Central).

### 1266-A1, A4, A7, A8, E3, F4

### AGRICULTURE IN THE ENVIRONMENT

Environmental Protection Agency.
J. L. Buckley
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 1-7.

Descriptors: *Agriculture, *Environment, *Farm wastes, *Air pollution, *Water pollution, *Soil contamination, Industrial wastes, Municipal wastes, Feed lots, Research and development.
Idenitfiers: *Environmental Protection Agency, National Environmental Research Centers.

This lead symposium paper for the Cornell Agricultural Waste Management Conference called for two basic accomplishments: (1) to find ways to halt agricultural pollution, and (2) to find uses for agricultural wastes. Agricultural pollution was defined and the EPA's role in eliminating it was discussed. (Lynch-East Central).

### 1267-A3, A8, F1, F2, F3

### ECONOMIC IMPACT OF AGRICULTURAL POLLUTION CONTROL PROGRAMS

Federal Reserve Bank of Kansas City.
R. J. Doll
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 9-16, 3 tab, 3 append.

Descriptors: *Agriculture, *Technology, *Management, *Economic impact, *Control, *Regulation, Agricultural runoff, Kansas, Feed lots.
Identifiers: *Agribusiness, Tenth Federal Reserve District.

Flexible regulatory systems governed by enlightened administrations are needed to replace existing uniform pollution control programs for agriculture. These systems should be viable and flexible enough to adequately control the environment without unduly restricting economic growth. An example is pollution caused by runoff of nitrogen-based fertilizers and other chemicals. Such runoff must be brought under control. The real problem is how to minimize such pollution, but, at the same time, permit the efficiencies achieved by technology. The proposal that the amount of a given chemical used per acre should be limited seems an incorrect approach because of the influence of such variables as soil type, climate, topography, method and time of application, and soil preparation tactics. (Lynch-East Central).

### 1268-B1, F1, F4

### PUBLIC RELATIONS ASPECTS OF AGRICULTURAL WASTE MANAGEMENT

Graham Farms,
D. B. Graham
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 17-24.

Descriptors: *Farm wastes, *Waste treatment, *Recycling, Pollution abatement, Odor, Waste disposal.
Identifiers: *Public relations, *Agricultural Waste Management.

An overview of animal waste management methods and economic implications is presented to show that the public must be informed about the farmer's pollution problems and solutions. There is a need for public acceptance of farm wastes as a valuable recyclable resource. (Lynch-East Central).

## 1269-A2, B1, D1, D2, E1, E3, F2

### IMPLICATIONS OF THE PERMIT PROGRAM IN THE POULTRY AND ANIMAL FEEDING INDUSTRY

Office of Research and Monitoring, Environmental Protection Agency.
D. F. Anderson
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 25-45. 8 fig, 9 tab, 35 ref.

Descriptors: *Waste disposal, *Water pollution treatment, *Water permits *Feed lots, *Agricultural runoff, *Waste treatment, Water pollution, Water law, Waste water disposal, Livestock, Biochemical oxygen demand, Chemical oxygen demand, Poultry.
Identifiers: *Pollution discharge, Executive Order Number 11574, Zero discharge.

Now in suspension, Executive Order Number 11574 called for the U. S. Army Corps of Engineers to assume responsibility for issuing permits for all industrial pollution discharges into navigable streams and their tributaries. Permits for agricultural discharges into waterways were to apply to operations of 1000 animal waste units and larger with violators subject to fines and/or injunction. The proposed national goal was 'zero discharge" by 1985. New methods of meeting discharge requirements such as sedimentation, lagooning, and recycling were proposed. Pollutant concentrations in runoff and water discharge as well as methods of disposing of animal wastes are cited. (Lynch-East Central).

## 1270-A4, A5, F2

### APPLICATION OF IOWA'S WATER POLLUTION CONTROL LAW TO LIVESTOCK OPERATIONS

Iowa State Department of Health.
U. Agena
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 47-59.

Descriptors: *Regulation, *Water law, *Water permits *Water pollution control, *Farm wastes, *Livestock, *Feedlots, *Iowa, *Waste disposal, Waste treatment, Inspection, Poultry, Runoff.
Identifiers: *Permit requirements, *Iowa Water Pollution Control Law, Rural Environmental Assistance Program (REAP), Water discharge.

In conjunction with the Agricultural Stabilization Conservation Service, the Soil Conservation Service, and the Cooperative Extension Service, the Iowa Water Pollution Control Commission became responsible for prevention, control, and abatement of water pollution in that state in 1965. The commission registers feedlots, evaluates feedlots for pollution potential, and issues permits for waste disposal. Requirements for feedlot registration and regulation based on the number of confined animals and the destination of the runoff water are defined and outlined. (Lynch-East Central).

## 1271-A1, B1, F2

### A REVIEW OF PUBLIC AND PRIVATE LIVESTOCK WASTE REGULATIONS

Missouri University, Columbia.
D. R. Levi
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York. p. 61-69.

Descriptors: *Regulation, *Farm wastes, *Livestock, *Feed lots, *Zoning, *Civil law, Permits, Water pollution, Legal aspects, Contracts, Air pollution, Waste disposal, Pollution abatement.
Identifiers: *Public regulation, *Private regulation, Licensing law, Injunctions, Site selection.

All states now have very similar public regulatory agencies which control pollution by adhering to precise tolerance mandates. When tolerance levels are exceeded, the board may seek an injunction, assess daily fines, institute a lawsuit to recover damages or issue tax bills for construction of adequate pollution control facilities. Private regulation, uncertain and unpredictable due to dependence on a jury, occurs indirectly in civil lawsuits through the nuisance laws. Under these laws a plaintiff may sue for injunction, damages, or both. Feedlot operators were advised to consider zoning, site selection, and prior occupation in setting up new operations. (Lynch-East Central).

## 1272-B1, F1, F2

### IMPLICATIONS OF STATE ENVIRONMENTAL LEGISLATION ON LIVESTOCK WASTE MANAGEMENT

U. S. Department of Agriculture, Michigan State University.
J. B. Johnson, L. J. Connor, C. R. Hoglund, and J. R. Black.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 71-81. 4 tab, 7 ref.

Descriptors: *Economic efficiency, *Legislation, *Environment, *Livestock, Pollution abatement, Permits Control, Confinement pens.
Identifiers: *Waste management, Administrative codes, Legislative proposals, Registration critera.

A 1971 survey of statutes in 27 major beef-producing states revealed a mixture of general statutes, specific registry statutes, administrative codes, approval procedures, and permit systems. Tables show percentages of beef produced in the states surveyed, the forms of state water pollution statutes applicable to livestock waste management, critera for registration requirements of livestock and poultry production firms, and critera for registration requirements of permits provided by general state water quality statutes. Implications of these statutes for both beef producers and society were broadly discussed. (Lynch-East Central).

## 1273-F2

### POTENTIAL CITIZEN INITIATED LEGAL ACTION AGAINST AGRICULTURAL POLLUTION

West Virginia University, Missouri University.
D. Colyer, and D. R. Levi.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 83-95. 37 ref.
Descriptors: *Regulation, *Legal aspects, *Control, *Pollution abatement *Common law, Discharge.
Identifiers: *Citizen initiated legal action, *Agricultural pollution, *Mandamaus, Class action, Constitutional provisions, Public trust doctrine.

Feasible individual or group action against pollution is outlined. Citizens may seek a judicial decree constraining administrators to perform environmentally-related duties, usually through mandamus, or bring direct suit against a polluter. Plaintiffs may sue polluters under nuisance laws, illustrating intentional and unprivileged entry onto land, or under trespass laws, requesting an injunction, damages or both. They may also utilize class or declatory judgment actions. The Refuse Act of 1969, and the ninth amendment to the Constitution have also guaranteed the rights of the individual to a clean environment. (Lynch-East Central).

## 1274-A4, B4, E2, F2

### DAIRY FARMER CONCERNS OF LAWS AND REGULATIONS AFFECTING ANIMAL WASTE MANAGEMENT

National Milk Producers Federation.
J. B. Adams
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 97-100.

Descriptors: *Dairy industry, *Farm wastes *Regulation, *Legislation, *Water pollution, *Waste disposal, Permits.
Identifiers: *Waste management, National Milk Producers Federation, U. S. Public Health Service.

The National Milk Producers Federation has adopted an environmental issues policy which recognizes the need for reasonable balance between animal agriculture, costs to consumers, and future environmental quality. Dairymen face a problem in complying with conflicting federal regulations. According to the U. S. Public Health Service, in order to maintain a license to produce Grade "A" milk, a dairy must regularly remove and deposit manure on the land. On the other hand, most water pollution regulations require a retention of the manure or other means of preventing animal wastes' entrance into public waters. Obviously, dairymen can't comply with both regulations at the same time. Many regulations also require a permit to discharge animal wastes into navigable waterways. This "across the board approach" fails to accomodate the flexibility required to enable producers to employ practical solutions to individual problems. (Marquard-East Central).

## 1275-D2, E1

### PYROLYSIS AS A METHOD OF DISPOSAL OF CATTLE FEEDLOT WASTES

Midwest Research Institute.
W. Garner, C. E. Bricker, T. L. Ferguson, C. J. W. Weigand, A. D. McElroy.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York p. 101-123. 7 fig, 5 tab, 10 ref.

Descriptors: *Farm wastes, *Waste disposal, *Feed lots, *Cattle, *Cost analysis, Cellulose, Lignin, Differential thermal analysis,
Identifiers: Pyrolysis, Hemicellulose, Thermogravimetric analysis, Organic fractions.

A program was conducted to determine the economic feasibility of pyrolyzing feedlot wastes. Background theory on pyrolysis of cellulose, hemicellulose and lignin, and wood is given. The pyrolysis process is pictured and diagramed and test results are given. Composition of noncondensables, elemental analyses, material and energy balance, and economic evaluation of a pyrolyzer for manure from a 40,900 head beef cattle feedlot are given. The conclusion was that pyrolysis of feedlot wastes was uneconomical in relation to simple incineration because cost of equipment to separate potential marketable material was not offset by the market value of the materials. (Marquard-East Central).

## 1276-B1, D2, D3, E1, E2, F4

### DAIRY MANURE WASTE HANDLING SYSTEMS

A. Grimm
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference Ithaca, New York, p. 125-144, 1 fig, 3 tab, 7 ref.

Descriptors: *Dairy industry, *Waste disposal, Waste treatment, Aeration, Activated sludge, Incineration, Cattle.
Identifiers: *Dairy manure, *Waste handling systems, *Centralized dairies, *Decentralized dairies, Dirt corrals, Paved corrals, Direct disposal, Dewater solids, Compost, Liquid flush, Oxidation ditch, Dairymen's Fertilizer Cooperative Pyrolysis, Southern California, Cerritos, California.

Because of complete urbanization of such areas as Cerritos, California, a program was initiated in southern California to study and demonstrate improved methods of handling raw manures at individual dairies and feedlots in highly populated areas. Individual system's costs are presented in tabulated form. Evaluations were made for ten decentralized individual dairy waste handling systems: four for a dirt corral dairy and six for a paved corral dairy. Eight centralized, regional dairy waste handling systems were analyzed. A schematic shows a comparison of environmental effects of waste handling systems and system operating cost. The conclusions of the study were: (1) disposal of manure from each decentralized dairy should be accomplished in the most economical manner with the least detrimental environmental effect, and (2) in view of a diminishing number of dairies, construction and operation of a centralized waste disposal plant did not appear justified in the Cerritos area. (Marquard-East Central).

## 1277-C2, D3

### AERATION RATES FOR RAPID COMPOSTING OF DAIRY MANURE

United State Department of Agriculture.
G. B. Wilson and J. W. Hummel
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 145-158. 12 fig, 2 tab, 9 ref.

Descriptors: *Dairy industry, *Farm wastes, Chemical oxygen demand, Nitrates, Ammonia.
Identifiers: *Composting, *Aeration rates, *Bench composter *Bin composter, *Mechanized channel, Oxygen consumption rate.

Studies were undertaken to develop design criteria for composting operations. Bench composters, bin composters, and a mechanical channel were the three methods used for development of aeration rates. A generalized curve was developed showing the effects of aeration on temperature and rate of oxygen consumption at any one time during the process. Aeration rates should vary in the process in the following sequence: (1) during warmup stage, aeration should be applied at increasing rates; (2) when thermophilic temperature is reached, the aeration rate should be increased to the top of the temperature limit: and (3) as the level of activity decreased the rate of aeration should be reduced to prevent cooling. (Marquard-East Central).

## 1278-A6, B3, B5, D3

### WINDROW COMPOSTING OF SWINE WASTES

Cornell University.
J. H. Martin, Jr. and M. Decker, Jr. and K. C. Das
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 159-172. 10 fig, 5 tab, 7 ref.

Descriptors: *Hogs, *Waste treatment, Hydrogen ion concentration.
Identifiers: *Composting, *Swine wastes, Windrow, Thermophilic environment, adulteration.

A study was performed to determine the feasibility of composting swine wastes. Criteria for evaluation were control of odors, time required for stabilization, volume reduction, and characteristics of the end product. Evaluation of the composting process was accomplished in two phases: (1) windrow formation creating aerobic conditions conducive to thermophilic activity and (2) maintenance of conditions for rapid stabilization. The findings were: (1) a direct correlation was observed between odor control and development of thermophilic environment; (2) increasing the turning frequency had a significant effect on the composting process; (3) adulteration of the material was successful in reducing the time before odors were controlled and minimizing time for completion when straw was used; (4) volume reduction and final material was satisfactory, and (5) composting can be a satisfactory method for treating swine manure and provides an alternative to liquid systems. (Marquard-East Central).

## 1279-A6, A10, B3, D1

### REDUCTION IN MOISTURE AND DAILY REMOVAL OF WASTES FROM CAGED LAYING HENS

A. D. Longhouse
West Virginia University.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 173-185. 9 fig, 6 tab.

Descriptors: *Farm wastes, *Waste disposal, Ammonia.
Identifiers: *Caged laying hens, *Moisture reduction, Vertically tiered cages, Dryer conveyor, Dropping boards, Scraper.

Research objectives were to remove manure daily from laying hens in vertically tiered cages and to begin moisture removal promptly, thus preventing odor development (especially of ammonia) and restrictive vectors. To accomplish these objectives, the research facility was equipped with a dryer-conveyor, dropping boards, a scraper mechanism, and an automatic control for solenoid steam valve. Figures show construction design. Results of a five-day test are tabulated. The research, at this time indicates that it is possible to eliminate odors and flies in a poultry house when the manure is removed at least once daily, thus making it possible to increase the bird population 25 to 100 percent—thereby paying for added mechanization. (Marquard-East Central).

## 1280-B3, C1, D1

### UNDERCAGE DRYING OF LAYING HEN MANURE

Cornell University.
A. T. Sobel
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 187-200, 12 fig, 2 tab, 3 ref.

Descriptors: *Forced drying, *Farm wastes, *Poultry, *Attractants, *Waste disposal, Odor, Particle size, Particle shape, Temperature.

Identifiers: *Undercage drying, *Laying hen manure, Fins, Screens, Slot outlets Air velocity, High-rise laying house, Bird concentration.

Two systems for undercage drying of chicken manure were investigated. The first system employed mechanical devices and no forced air. Test results indicated metal fins placed at angles beneath cages offer more efficient drying than mesh screen. Percentage results of various angle are listed. The second system utilized forced air drying in bird rooms with slot outlets and a high rise laying house. This was the only system studied on a full size field operation. An average drying curve for undercage drying with forced air and slot outlets and a summary of moisture contents obtained for various undercage drying systems are presented in schematics. Observations from the study indicate (1) the high-rise house presented the largest range of moisture contents, (2) shallow bed system (forced air) presented the smallest range of moisture, and (3) all the systems removed moisture to moisture contents below 60 percent. (Marquard-East Central).

## 1281-B3, B4, C1, C2, D2

### STORAGE OF MANURE SOLIDS BY FORMING SOIL-MANURE PELLETS

Iowa State University,
R. D. Larson, T. E. Hazen and J. R. Miner
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 201-210. 5 fig, 5 tab, 5 ref.

Descriptor: *Hydraulic transportation, *Farm wastes, *Waste storage, Moisture content, Physical properties, Hydrogen ion concentration, Nitrogen, Carbon dioxide, Ammonia.
Identifier: *Soil-manure pellets, Hydrated lime, Webster silty clay loam, Volitalization.

A progress report is made which concerns moisture content, pH effects and nitrogen/CO2 evolution in the pelleting process of animal manure. Soil and lime are added to manure solids to help produce pellets. Soil is used as a dewatering and binding agent to control moisture content and lime is used to increase pH. Nitrogen/CO2 evolution is tested by 5 and 10% lime treatments. Conclusions are: (1) Addition of lime increases ammonia loss from a soil, lime and manure mixture; the rate of evolution increases significantly above pH 11. Moisture content does not greatly effect rate of evolution. (2) Biological activity, represented by carbon volatilization increases with the addition of 2.5% d.b. hydrated lime. Further lime additions decrease activity. At the 10% lime level, growth is arrested. Little or no growth occurs above pH 9. In most treatments, moisture-content increases were accompanied by marginal increases in carbon-dioxide evolution. (3) Manure solids exhibit a buffering capacity. The solids have an ability to retard pH increases with increasing lime contents. A pH range from 9 to 11 would be desirable in order to mutually minimize ammonia and carbon evolution. (Marquard-East Central).

## 1282-A2, A4, A5, A8, B2, C1, C2, D1

### CHEMICAL STUDIES OF SOLIDS, RUNOFF, SOIL PROFILE AND GROUNDWATER FROM BEEF CATTLE FEEDLOTS AT MEAD, NEBRASKA

United States Department of Agriculture, Purdue University.
T. M. McCalla, J. R. Ellis, C. B. Gilbertson, and W. R. Woods
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 211-223. 5 fig, 5 tab, 5 ref.

Descriptors: *Feedlots, *Agricultural runoff *Soil profile, *Slope, *Continuous flow, *Chemical properties, Groundwater, Nitrogen, Phosphorous, Solid wastes, Cattle, Nebraska.
Identifiers: *Batch system, *Settleable solids, Cattle density, Electrical conductivity.

This 4-year study at Mead, Nebraska, was made to determine the effects of cattle density and slope on possible pollution of surface water, soil profile, and groundwater from beef cattle feedlots. The batch system and the continuous flow system were used for removal of settleable solids from runoff. Chemical analyses were made of the wastes and runoff produced by these two systems. Conclusions were:

1. Feedlot runoff transports excess nutrients and must not be discharged into streams.
2. The quantity of volatile solids and nitrogen and phosphorous removal rates from the feedlot surface were proportional to stocking rate during mechanical cleaning.
3. An increase in the slope of the feedlot increased the quantity of total solids, volatile solids, nitrogen and phosphorous removed from the feedlot.
4. The runoff data on these lots indicate that the variability is too great to determine the effect of feedlot slope on runoff quantity and quality.

5. Beef cattle feedlots with heavy, constant stocking on loess hills do not create a groundwater problem but nitrate buildup was found in profiles of adjacent areas.
6. The soil texture of the retention structure and the procedure and materials used to seal the structure are necessary considerations in preventing nitrate accumulations in the soil profile and groundwater. (Marquard-East Central).

### 1283-A2, A4, C1, C2

### BEEF BARNLOT RUNOFF AND STREAM WATER QUALITY

United States Department of Agriculture.
R. K. White, and W. M. Edwards
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 225-235. 6 fig. 1 tab, 6 ref.

Descriptors: *Biochemical oxygen demand, *Chemical oxygen demand, *Water quality, Cattle, Ohio.
Identifiers: *Barnlot runoff, *Volatile solids, *Total solids, Clarksburg silt loam.

Objectives of the study presented were to determine the concentration and amounts of solids and organic material in the runoff from a barnlot and to identify the effect of rainfall and runoff patterns and seasonal conditions on barnlot runoff quality. Runoff for a 16-month period from a 60 head beef cattle barnlot located on silt loam was sampled and analyzed for total solids (TS), volatile solids (VS), biochemical oxygen demand (BOD), and Chemical oxygen demand (COD). Runoff usually occurs when rainfall exceeds .5 inches. Transport of TS is related to the volume of runoff. BOD concentration and transport are larger in winter and smaller in summer except for the periods following dry antecedent conditions. Concentrations of TS, BOD, and COD are variable within a runoff event. Average yearly runoff, based upon 3 year records is presented. A yearly BOD concentration curve for runoff is projected. An estimate of yearly transport of BOD can be projected from these two relations. (Marquard-East Central).

### 1284-A6, B2, B4, D3, E2, E3, F1

### AUTOMATED HYDRAULIC WASTE-HANDLING SYSTEM FOR A 700-HEAD SWINE FACILITY USING RECIRCULATED WATER

Iowa State University,
J. K. Koelliker, J. R. Miner, T. E. Hazen, H. L. Person, and R. J. Smith.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 249-261. 8 fig, 1 tab, 6 ref.

Descriptors: *Hogs, *Recirculated water, *Farm wastes, *Waste storage, *Waste disposal, Irrigation, Estimated costs, Iowa.
Identifiers: *Automated hydraulic waste-handling system, Flush tanks, Sewer lines, Anaerobic lagoon, Return water system Slatted floors.

A swine waste handling system is described that for four years has operated with little attention, no handling of manure, low odors, and no effluent discharge into streams. The system uses an enclosed building in which swine waste is deposited into gutters. Flush tanks automatically flush the water into sewer lines and then to an anaerobic lagoon. From here some waste goes into the irrigation system for land disposal and lagoon effluent is returned to the flush tanks. Investment in the entire manure management system is estimated at $10-$15 per hog capacity. Detailed description and costs of the system are given. (Marquard-East Central).

### 1285-A2, A4, A6, B1, B2, D3, E2, F1

### OPERATIONAL PROBLEMS OF PORK PRODUCTION RELATED TO ENVIRONMENTAL QUALITY

Gehlbach Pork Farms, Inc.
A. E. Gehlbach.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 26[illegible]-265.

Descriptors: *Hogs, *Farm wastes, *Waste disposal, Confinement pens, Oxidation lagoons, Lagoons.
Identifiers: *Environmental quality, *Operational problems, *Soil injection, Pasture system, Collection pits.

A comparison is made of two pork production systems—the pasture system and the confinement system. An operational, problem of the pasture system is that heavy rains wash runoff into streams. The confinement system can prevent this and can dispose of waste in these ways: (1) collection pits, (2) oxidation ditches (3) lagoons. Problems of these are costs and inability to use them year round. Gehlbach Swine Farms uses soil injection to prevent runoff and odor; however, research is needed to solve these waste disposal problems: (1) find limits of animal waste applications to land, (2) prevent odor from swine buildings and (3) find proper operating procedures for lagoons. (Marquard-East Central).

### 1286-B1, D3, F1

### TREATMENT OF SWINE WASTES

Schuster Farms.
L. R. Schuster
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p, 267-270.

Descriptors: *Hogs, *Farm wastes, *Waste treatment, Confinement pens, Poultry, Bichemical oxygen demand, Costs.
Identifiers: Tank-aerator, Schuster Farms.

Schuster Farms' manager reports that the swine aerator system was chosen as a means of waste treatment due to: (1) Closed loop with zero runoff, (2) Adaptability to existing facility, (3) Ready accessibility for maintenance,(4) Ease of operations. Tank design and aeration rates are given for a 100 sow operation. Water area of the system is 18x38x10 ft. and with the waste containing a five day biochemical oxygen demand of 33,000 mg/1 and an oxygen uptake rate of 43 mg/1/hr., the system requires transfer of 21.5 lbs. of oxygen per hour at 20 degrees centig&rade. Based on this, pumps must be capable of pumping at least 635,000 gal/hr. or the equivalent of turning over the tank's content once every 4.7 minutes. Costs and savings through use of such a system are discussed, (Marquard-East Central).

### 1287-A5, A11, B2, C2, D3

### AN EVALUATION OF THREE HYDRAULIC MANURE TRANSPORT TREATMENT SYSTEMS, INCLUDING ROTATING BIOLOGICAL CONTACTOR, LAGOONS AND SURFACE AERATORS

Iowa State University.
H. L. Person, and J, R. Miner
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 271-288. 5 fig, 9 tab, 1 ref.

Descriptors: *Hogs, *Farm wastes, *Waste treatment, *Waste water treatment, Lagoons, Confinement pens, Nitrogen, Ammonia, Rotating biological contactor, Chemical oxygen demand, Biochemical oxygen demand, Effluent, Iowa.
Identifiers: *Hydraulic manure transport systems, Anaerobic lagoon, Aeration basin, Recycled water, Flushing gutters, Surface aerators, Bilsland Memorial Research Station.

Three different waste treatment systems that use flushing gutters and recycled treated waste waters for cleaning are reported. System 1 uses flushing gutters and an aeration basin; system 2 uses flushing gutters, an anaerobic lagoon and a rotating biological contactor. Each system is diagramed and specific details and dimensions are given. Effectiveness of the three systems in terms of effluent control is summarized. It was found that (1) discharging effluent down flushing gutters was an effective means of removing manure from swine buildings, (2) treated effluent did not inhibit normal swine growth, (3) recycled wastes did not cause excessive odor problems, (4) the effluent from the RBC system and lagoon, aeration-basin system presented a few pumping problems, and (5) the aeration-basin effluent contained more solids and had clogged return lines more frequently. (Marquard-East Central).

### 1288-A6, B3, C1, C2, D2, E3, F1

### DRYING POULTRY MANURE AND REFEEDING THE END PRODUCT

J. F. Bergdoll
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 289-293.

Descriptors: *Poultry, *Farm Wastes, *Recycling, Nitrogen, Costs, Nutrients, Odor, Fertilizers Indiana.
Identifiers: *Refeeding, *Dried poultry manure.

Berry Best Egg Company's program for drying poultry manure into a feed is reported. The manure is dried to a 10-15% moisture content No odor is reported when 10% level is reached; however, from the 12-15% moisture level, there is a slight smell. Cost for a dryer runs from $22,000 to $70,000 and total operational costs run from $15 to $35 per ton. Nutrient Value/Nitrogen is highest when manure is dried daily. Optimum level for waste in a feed ration is 10 to 15%; however, it is recommended that birds should start eating a ration at eight weeks of age and work up ot a 30% level. Egg production results are given. (Marquard-East Central).

### 1289-A11, B3, B4, C2, E3

### THE EFFECTS OF CONTINUOUS RECYCLING AND STORAGE ON NUTRIENT QUALITY OF DEHYDRATED POULTRY WASTE (DPW)

Michigan State University,
C. J. Flegal, C. C. Sheppard, and D. A. Dorn
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 295-300. 5 tab, 5 ref.

Descriptors: *Poultry, *Farm wastes, *Waste storage, *Nutrients, Calcium, Phosphorous, Nitrogen.
Identifiers: Continuous recycling, *Dehydrated poultry wastes, Crude protein.

One experiment was conducted to determine the influence of poultry waste storage time on the nutrient quality of dried poultry wastes. Another experiment tested what continuous recycling does to dried poultry waste nutrient quality. In the first experiment, droppings were collected and stored prior to drying from periods ranging from 1 to 90 days. In general, when the material was held for longer than 28 days, crude protein content went down. In experiment 2, pullets were fed rations for 412 days. The diets containing DPW were continuously recycled. At the completion of 31 cycles, the proximate analyses of the DPW from the birds fed the continuously recycled DPW were quite similar. However, both calcium and phosphorous were slightly higher than DPW from hens fed a standard cage laying ration, Hen housed egg production of the birds fed the 12.5 percent DPW diet was slightly higher than the hen housed egg production of the other birds. Birds fed the diet containing 25 percent DPW consumed the most feed. Mortality of the birds fed the three diets ranged from 6.9 percent to 7.9 percent. (Marquard-East Central.

## 1290-A11, B3, C2, E3, F1

### EVALUATION OF DEHYDRATED POULTRY MANURE AS A POTENTIAL POULTRY FEED INGREDIENT

Cornell University.
M. C. Nesheim
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 301-309. 7 tab, 6 ref.

Descriptors: *Poultry, *Farm Wastes, *Feeds, *Recycling, *Evaluation, Economics, Amino acids, Phosphorus.
Identifiers: *Refeeding, *Dehydrated poultry manure, *Metabolizable energy, Egg production, Feed consumption.

Cornell experiments were made to evaluate poultry waste as a poultry feed ingredient. The experimenters felt that the metabolizable energy content of the poultry waste was the best single overall measure of its potential value as a feed ingredient. Test hens were fed computer formulated rations of which diets 1 2, and 4 were low energy content while diet 3 was a typical commercial energy diet. Diets 1 and 4 had 22.5% poultry waste as an ingredient of their rations. Results revealed that egg production was high for all four diets; however, hens on diets 1, 2, and 4 ate more than those on diet 3. There was also a marked increase in excreta dry matter for these hens. This indicated that only a portion of the manure was actually lost in recycling. The computer analysis indicated that poultry waste would be used as a preferred source of phosphorus in the ration until it reached a cost of $26.00 a ton with the feed ingredients used. Its high phosphorus content along with the associated amino acids and energy made it a preferred source of phosphorus in the ration compared to meat meal and decalcium phosphate. (Marquard-East Central).

## 1291-A6, B2, D2, E2, F2

### OPERATIONAL PROBLEMS OF POULTRY PRODUCTION RELATED TO ENVIRONMENTAL QUALITY

Kreher Poultry Farms.
H. J. Kreher
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 311-316.
Descriptors: *Waste disposal, *Poultry, *Air pollution, *Odor, *Legal aspects, Technology, Ozone, New York.

Identifiers: *Operational problems, *Environmental quality, Liquid manure spreader, Soil injection.

Waste disposal is the main operational problem of Kreher Poultry Farms, a 60,000 hen poultry farm in New York. When land disposal of liquid manure became objectionable to a nearby population, ozone treatment was used to reduce odors. Due to maintenance breakdowns, the odors persisted and the farm owners were taken to court. The owners were faced with a $200 settlement for their violations. These owners feel that this was an unfair judgement and that there is a desperate need for an objective third party—an agriculture industry panel made up of people acquainted with agricultural problems and agricultural research. Such a council could give sound recommendations to farmers in trouble. (Marquard-East Central).

## 1292-A6, B2, D3, E2

### AUTOMATED HANDLING AND TREATMENT OF SWINE WASTES

The Ohio State University.
E. P. Taiganides, and R. K. White.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 331-339. 12 fig.

Descriptors: *Hogs, *Farm Wastes, *Waste treatment, *Oxidation lagoons, Odor.
Identifiers: *Automated handling, Flushing gutters, Recycled waste water, Siphon tanks.

A plant was constructed on Botkins Feed and Grain Company Research Farm, Botkins, Ohio, in order to study the feasibility of automatically removing swine wastes, treating them, and recycling treated effluent back to the building to flush out further wastes. The plant operated as follows. A tank located at the end of the gutter was filled with water which was siphoned onto the gutter. The flushing water carried the dung defecated on the gutter to a sump from where the waste water was pumped onto a stainless steel screen. At the screen, the solids were separated from the liquids. Liquids were discharged into the oxidation ditch, clarified and the supernatant from the final clarifier was pumped back into the siphon tanks in the animal building. Meanwhile the solids separated by the screen were aerobically digested, stored, and pumped onto crop land. After twenty weeks of operation, the automated removal of waste was working extremely well and odor control was good, but the oxidation ditch was malfunctioning and foaming. At the time of this report, it was hoped that the system would be monitored two more years and that procedures would be developed to make the plant operate optimally at all times. (Marquard-East Central).

## 1293-A6, A8, A11, B2, C2, D3, E2

### EVALUATION OF SWINE WASTE TREATMENT ALTERNATIVES

North Carolina State University.
F. J. Humenik, R. W. Skaggs, C. R. Willey, and D. Huisingh.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 341-352. 1 fig. 11 tab, 6 ref.

Descriptors: *Hogs, *Farm wastes, *Waste treatment, *Evaluation, *Waste disposal, Nitrogen Chemical oxygen demand, Phosphorus, Heavy metals.
Identifiers: *Land disposal, *Unaerated lagoons, *Application rates, Cecil sandy loam, Norfolk sandy loam.

This North Carolina study reports on the treatment of swine waste by a single unaerated lagoon, the treatment of swine waste by an unaerated series lagoon system, and data for land disposal of effluent from a single unaerated lagoon. The experiment revealed that an unaerated series lagoon can handle twice the number of animals that a single aerated lagoon can take care of and there is no increase in odor. Specific conclusions drawn from the study were:
(1) Major constraints in using lagoon systems in the Southeast are the disposal of excess liquid and the potential of odor and excess leakage.
(2) A conservative estimate of allowable nitrogen loading when using land disposal of wastes in the Southeast appears to be 15 lb./acre/week for Cecil sandy loam and 10 lb./acre/week for Norfolk sandy loam.
(3) Heavy metal feed additives can pose an environmental and health hazard, i.e. the copper content of the soil-plant disposal system may approach levels that poison the soil and/or are toxic for sheep and other animals. However, lagoons can be utilized as a copper trap prior to land disposal. (Marquard-East Central).

## 1294-A2, B2, D1, D3, D3, F1

### DEVELOPMENT OF A SYSTEM AND A METHOD FOR THE TREATMENT OF RUNOFF FROM CATTLE HOLDING AREAS

Kappe Associates, Inc., Rockville, Maryland.
D. S. Kappe.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 353-363. 2 fig. 2 tab.

Descriptors: *Waste treatment *Farm wastes, *Agricultural runoff, *Waste disposal, *Cattle, *Dairies, *Confinement pens, Aerobic treatment, Anaerobic conditions, Sludge, Hydrogen ion concentration, Chemical properties, Economics, Maryland.
Identifiers: *Waste management research, *Aeration tank.

At the time of this paper's presentation, Kappe Associates Inc, and J. L. Mills Brooklawn Dairy Farm had just completed construction of a dairy farm waste treatment system. A description is given of the project site, the experimental treatment system, and the studies that were to be made. The treatment system consisted of a concrete flow metering box; an aerated grit chamber; a dual section aeration tank with a hopper bottom; a chlorine contact tank, a pump and piping system that enabled treated and chlorinated waterwaste to be used for washing down the treatment facility and flushing the holding area; and a small building, which housed two blowers for supplying air to the aeration tank; the chlorinator for the facility; the treatment system electrical control panel; an air flow meter for measuring the air flow to the aeration tanks; a wastewater flow recorder; and other mechanical equipment; as well as the project site laboratory. The system was designed essentially to utilize the extended aeration modification of the activated sludge waste treatment process and to operate on a "fill-and-draw" basis. The treatment methods to be studied were based on biological processes or combination of biological processes. (Marquard-East Central).

## 1295-A4, A6, B2, B4, E2, F1

### EVALUATION OF BEEF WASTE MANAGEMENT ALTERNATIVES

Oklahoma State University, Stillwater Oklahoma.
A. R. Butchbaker; J. E. Garton; G. W. A. Mahoney; and M. D. Paine.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 365-384. 7 fig, 6 tab, 21 ref,

Descriptors: *Cattle, *Farm wastes, *Waste treatment, *Waste disposal, *Waste storage, Climates, Slurries, Costs, Agricultural runoff, Solid wastes, Farm lagoons, Legal aspects.
Identifiers: *Waste management alternatives, *Confinement buildings, Open feedlots, Site selection.

Waste management design alternatives are outlined for both open and housed feedlot feeding facilities. Among the major conclusions are these: (1) No treatment systems for liquid feedlot wastes produce an effluent suitable for discharge to a stream. (2) Areas where moisture deficit is greater than 10 inches, have high potential for using exaporation for ultimate control wastes. (3) Paving open feedlots reduces pen surface area and runoff control structure sizes to about one-third of the area and sizes required for unpaved feedlots. (4) Confinement buildings offer a high potential for pollution control. Capital costs are higher than for open feedlots, but land areas are reduced, rainfall runoff structures are unneccessary and wastes may be removed either as a semisolid or as a slurry. (5) A slurry hauling system utilizing soil injection for handling liquid wastes from storage pits provides an optimum system for abatement of odors and water pollution, but is more expensive and slower than surface spreading. (6) A manure irrigation system for pumping a slurry or wastewater for field application costs about one-half as much as mechanically hauling and spreading a slurry within one-half mile of the feeding facilities. (7) Ultimate disposal of feedlot waste on agricultural land should be encouraged. (Marquard).

## 1296-A2, B1, B5, D3, E2

### CHARACTERISTICS OF WASTES FROM SOUTHWEST BEEF CATTLE FEEDLOTS

Texas Tech University.
Dan M. Wells; George F. Meenaghan; Robert C. Albin; Eugene A. Coleman; and Walter Grub.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 385-404. 5 fig. 17 tab.

Descriptors: *Feed lots, *Farm wastes, *Southwest U. S., *Waste treatment, *Wazte disposal, Feeds, Slopes, Semiarid climates Texas.
Identifiers: *Concrete-surfaced feedlots, *Dirt-surfaced feedlots, Waste characteristics Composting.

Texas studies conducted on concrete-surfaced feedlots and on dirt-surfaced feedlots with varying degrees of slope yielded the following conclusions: (1) Pollutant concentrations of runoff are in a range of one to more than two orders of magnitude higher than concentrations found in untreated municipal sewage. (2) Treatment of runoff from Southwestern cattle feedlots is infeasible. (3) Concentrations of pollutants in runoff resulting from precipitation on concrete-surfaced lots are two to four times greater than corresponding concentrations from dirt-surfaced lots. (4) The quantity of solid waste accumulating on the feedlot floor is a direct function of the fraction of roughage in the finishing ration. (5) The fraction of incident precipitation running off concrete lots is twice the fraction running off dirt-surfaced lots. (6) Stocking rates above 40 square feet per animal on concentrate lots do not enhance animal performance. (7) Limited feeding trials utilizing a roof to eliminate runoff had no effect on cattle performance. (8) Increasing slope of concrete feedlots from 7½ to 15 percent makes lots virtually self-cleaning. (9) Aerobic composting of solid wastes is technologically feasible regardless of the type of operation. (10) Extreme caution must be exercised in application of feedlot runoff to agricultural crops. (Marquard-East Central).

## 1297-A8, B2, C2, D3

### INITIAL OBSERVATIONS OF SEVERAL MEDIUM SIZED BARRIERED LANDSCAPE WATER RENOVATION SYSTEMS FOR ANIMAL WASTES

Michigan State University.
A. E. Erickson; J. M. Tiedje; B. G. Ellis; and C. M. Hansen.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 405-410. 1 fig. 2 tab, 2 ref.

Descriptors: *Waste water treatment, *Waste disposal, *Farm wastes, *Water pollution, *Soil contamination, *Nitrogen, *Phosphorus, Denitrification, Carbon, Livestock, Hogs, Nitrates, Effluent, Aquifer.
Identifiers: *Barriered Landscape Wate Renovation System (BLWRS).

Adsorption and filtering action of soils can be used to renovate waste water, but the expense of land and its management, as well as land availability in many places, has forced the intensive spreading of wastes on limited acreages with the possible pollution of water resources. Because there is a need for a method of renovation which is more efficient, doesn't require such large land areas, and is not as expensive as conventional sewage treatment and disposal, BLWRS (Barriered Landscapehal:we Renovation System) has been developed. It consists of a limestone or slag covered mound of soil underlain by an impervious water barrier. BLWRS's method is relatively inexpensive to construct, requires a minimum of maintenance, requires a smaller area than is needed for irrigation spreading systems, and removes large amounts of the nitrogen, carbon and most of the phosphate from the local environment. Tests are too incomplete for BLWRS's to be used commercially, but so far its nitrogen and phosphate removal capability has been as high as 99% for animal wastes. (Marquard-East Central).

## 1298-B2, C2, D2, E2

### REMOVAL OF PHOSPHORUS FROM LIQUID ANIMAL MANURE WASTES

Cornell University.
Raymond C. Loehr,
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 411-427. 4 fig. 2 tab, 4 ref.

Descriptors: *Farm wastes, *Liquid wastes, *Phosphorus, Waste water treatment *Waste disposal, Alum, Hydrogen ion concentration, Poultry, Ducks (domestic), Cattle, New York.
Identifiers: *Chemical removal, Alum, Ferric chloride.

This paper reports the results of detailed laboratory studies to remove phosphorus from duck, poultry, and dairy manure wastewaters and discusses the feasibility of such removal. The studies investigated the effect of phosphorus concentrations, pH control, different coagulants and wastewater source. The three chemicals used in the phosphorus removal experiments were: alum—$AL_2(SO_4)_3$; lime—CoO; and ferric chloride—$FeCL_3 6H_2O$. Actual comparison of the three chemicals was difficult since they were used in wastewaters of different characteristics and chemical demand. Chemical choice was determined by required dosage, chemical cost, and the costs of ultimate solids disposal. The alum requirements were less than those of lime for most poultry manure wastewaters; lime requirements were less for duck wastewater. Controlled land disposal should be considered a high priority method for phosphorus control from animal wastewaters because it is more amenable to normal animal production operations, avoids the need for chemical control and treatment plant operation, and eliminates additional problems of chemical costs and sludge production handling and disposal. (Marquard-East Central).

## 1299-A6, A8, B2, C2, E2

### CONTRIBUTION OF ANIMAL WASTE TO NITRATE NITROGEN IN SOIL

The Pennsylvania State University.
L. F. Marriot, and H. D. Bartlett,
Waste Management Research Proceedings of the Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 435-440. 1 fig, 2 tab, 1 ref.

Descriptors: *Farm wastes, *Waste disposal, *Nitrogen, *Soils, *Rates of application, *Slurries, *Water pollution, Groundwater, Dairy industry, Odor.
Identifiers: Hagertown silt loam, Suction lysimeters.

Research was done to determine the movement and accumulation of nitrate nitrogen in soil after dairy manure slurry was applied below the surface of grass sod. Odor control was also to be determined. A liquid spreader spread slurry of 12.5% solids and 2.35% total N (dry matter basis) four inches below surface at treatment rates of 0, 15, 30, 45, 60, and 75 tons of moisture. Suction lysimeters were installed in each plot at depths of 1 2, 3, and 4 feet for the purpose of sampling soil water. Samples were taken at 14 day intervals in 1970 and at monthly intervals in 1971. Soil samples were also taken. Both types of samples were analyzed for nitrate, ammonium nitrogen, chloride, and sodium. Even the lowest application rate of 15 tons per acre indicated enough nitrate excess to be a potential pollution hazard. Disposal of wastes in this manner practically eliminated odors. (Marquard-East Central).

## 1300-A8, C2, E2

### HEAVY MANURE APPLICATIONS: BENEFIT OR WASTE?

Department of Plant and Soil Sciences, Massachusetts University.
M. E. Weeks; M. E. Hill; S. Karczmarczyk; and A. Blackmer.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 441-447. 6 tab, 4 ref.

Descriptors: *Farm wastes, *Waste disposal, *Rates of application, Nitrogen, Phosphorus, Salts, Connecticut, Massachusetts.
Identifiers: Manure, Corn crop, Agawam sandy loam, Hadley sandy loam Chlorides.

A study was started to determine the effects of high rates of manure on the growth and yield of corn crops and on chemical and physical change in light textured soils. Three experimental sites with sandy loam soils were used. After two years of experimenting, the following was revealed: (1) Large manure applications on well-drained sandy loam soils should not adversely affect crop growth or yield. (2) Manure applications have a favorable effect on general tilth and workability of soil, (3) Nitrates, chlorides and other salts move through the soil profile at all levels of application, though during the growing season a crop of corn would utilize much of the nutrients as they become available, probably as high as 42 tons per acre. (4) Leaching would occur mainly before the crop is established and after it is removed. (5) Annual applications of manure for purposes of disposal on crop land should be made only after due consideration is given to location and total amount of area covered. The crops themselves were not analyzed for nitrate content. (Marquard-East Central).

## 1301-A8, C2, E2

### EFFECTS OF SOLID BEEF FEEDLOT WASTES ON SOIL CONDITIONS AND PLANT GROWTH

Kansas State University.
L. S. Murphy; G. W. Wallingford; W. L. Powers; and H. L. Manges.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 449-464. 15 fig, 2 tab, 12 ref.

Descriptors: *Feed lots, *Farm wastes, *Waste disposal, *Nitrogen, *Nitrates, *Phosphorus, Rates of application, Nutrient removal, Plant growth, Soil chemical properties Ions, Sodium, Potassium, Cattle, Kansas.
Identifiers: Electrical conductivity, Saturation extract conductivity, Greensburg silty clay loam, Silage yields,

Results of this two-year study indicate that large applications of solid beef feedlot manure can depress yields of corn silage. Silage yields were found to have a quadratic relationship to manure applications. Maximum yields were realized between 225 and 300 MT/ha. Depressed yields were due to accumulation of salts from manures. Electrical conductivity of the soil saturation extract increased linearly with manure applications. Sodium, potassium, phosphorus, NO3-N and nitrogen were found in large quantities in the soil; however, NO3 -N and nitrogen were not in large quantities of the corn silage, while phosphorus was. Results suggest that the detrimental effects of excessive manure application may be reversed by continued cropping and adequate water penetration of the soil. (Marquard-East Central).

## 1302-A2, A8, C2, E2

### GRASS RESPONSE TO APPLICATIONS OF BEEF-CATTLE FEEDLOT RUNOFF

United States Department of Agriculture.
M. B. Satterwhite, and C. B. Gilbertson.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 465-480. 3 fig, 7 tab, 27 ref.

Descriptors: *Feed lots, *Agricultural runoff, *Chemical analysis, *Rates of application, *Grasses Soil chemical properties, Nutrients, Soil profiles, Cattle, Nebraska.
Identifiers: Orchard grass, Little bluestem, Switchgrass, Reed canarygrass, Big bluestem, Intermediate wheatgrass, Brome grass, Sideoats grama, Indiangrass.

Field and greenhouse investigations were initiated to determine the response to various kinds of grasses to applications of beef feedlot runoff, Chemical aspects of the runoff, grasses tested, grass production, protein content, and soil analyses are tabulated. It was found that yearly variation in runoff could lead to death. Under controlled greenhouse conditions, grasses in order of decreasing response were: Orchard grass, Little bluestem, Switchgrass Reed canarygrass, Big bluestem, Intermediate Wheatgrass, Brome grass, Side-Oats Grama, and Indiangrass. (Marquard-East Central).

## 1303-A8, C2, E2

### A STUDY OF CORN RESPONSE AND SOIL NITROGEN TRANSFORMATIONS UPON APPLICATION OF DIFFERENT RATES AND SOURCES OF CHICKEN MANURE

Cornell University.
K. MacMillan, T. W. Scott, and T. W. Bateman
Waste Management Research, Proceeding of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 481-494. 8 fig, 10 tab, 5 ref.

Descriptors: *Farm wastes, *Rates of application, *Nitrogen, Potassium, Poultry, Electrical conductance, Acidic soils, Salts, Hydrogen ion concentration New York.
Identifiers: Chicken manure, Soil nitrogen transformation, Corn response, Oxidation ditch manure, Diffused air manure.

A 37-day greenhouse experiment was initiated to (1) determine corn response when extremely different rates of treated manure sources were applied to two typical New York soils differing in pH and (2) determine soil nitrogen transformations under the above conditions. Raw manure was applied at rates 0, 75, 155, 310, and 620u gN/gm soil. All other sources (stored oxidation ditch manure, oxidation ditch manure, and diffused air manure) were applied at rates 0, 125, 250, 500, and 1000u gN/gm, soil. It was concluded that: (1) High rates of manure applications did not result in excessive amounts of salts nor did it destroy the microbial population, (2) Luxury Nitrogen and potassium consumption resulted from the application of high rates of the manure sources studied, (3) In low pH soils the corn grew well; in high pH soils the effect of manure application was detrimental. This suggested that acid soils have the greatest potential for manure disposal and crop efficiency. (Marquard-East Central).

## 1304-A3, A8, C2, E2

### SURFACE RUNOFF NUTRIENT LOSSES FROM VARIOUS LAND DISPOSAL SYSTEMS FOR DAIRY MANURE

Agronomy Department, Cornell University.
P. J. Zwerman, S. D. Klausner, D. R. Bouldin, and D. Ellis.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York p. 495-502. 3 tab, 13 ref.

Descriptors: *Agricultural runoff, *Waste disposal, *Farm wastes, *Nitrogen, *Phosphorus, Nitrates, Dairy industry, Crop rotations, Corn, Alfalfa, Oats, Wheat, Organic matter, Rainfall simulators.
Identifiers: Nutrient losses, Manure, Soil loss Orthophosphate.

Sixty randomly selected plot locations were subject to surface runoff tests with a rainfall simulator. Storm frequencies corresponding to 2, 10, and 20 years were applied in sequence to each plot. Soil condition results represent the effects of fourteen years of past management on seed beds prepared for corn, Heavy mineral fertilization increased runoff by 50%. Lack of a 6 ton manure application increased runoff 100%. Orthophosphate was increased by increased phosphate fertilizer. Runoff, nitrate and orthophosphate increased with rain application. Increased mineral fertilization doubled the losses of soil, organic matter, total nitrogen, and total phosphorus. Six ton manure applications cut these losses in half. All losses increased with increased water applications. The two-by-four study again involved six tons of manure plowed down versus no manure on four crop rotations. All were at moderate rates of mineral fertilization. The rotations were: (1) continuous corn; (2) corn-corn-oats-alfalfa-alfalfa; (3) corn-oats-alfalfa-alfalfa; and (4) wheat-alfalfa-alfalfa-alfalfa-alfalfa. Manure effect in these rotations was non-significant. In (1) and (4), manure decreased or did not effect runoff, soil, and nutrient losses. In (2), manure significantly increased organic matter and total nitrogen loss. It increased runoff, nitrates, soil loss, and total phosphorus. In (3), manure significantly increased total phosphorus. It decreased nitrate. It increased soil loss, organic matter, and total nitrogen. (Marquard-East Central).

## 1305-B2, C1, C2, D3

### A STUDY OF FOAMING PROBLEMS IN AN OXIDATION DITCH TREATING SWINE WASTE

Toronto University,
P. H. Jones, and N. K. Patni.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 503-515. 14 fig, 2 tab, 3 ref.

Descriptors: *Farm wastes, *Swine, *Oxidation lagoons, *Foaming, *Waste treatment, Temperature, Hydrogen ion concentration, Suspended solids.
Identifiers: *Oxidation ditch, *Electronic foam sensor, Beloit-Passavant Rotor, Foam suppressants, Electrodes, Silicon controlled rectifier.

This study was conducted to examine the occurrence of foam and to determine the factors affecting foam generation in a full-scale oxidation ditch used for treatment of daily wastes of approximately 400 swine. Foam formation was monitored daily for 211 days and temperature, dissolved oxygen, pH, suspended solids, etc., were measured. A rotor operated within the ditch to promote aeration. Breaking the foam with water spray proved unsatisfactory. By the 6th week, foaming was acute. The use of winter fuel oil and commercial foam depressants proved unsatisfactory. A five foot high wooden head-box was constructed downstream of the rotor to catch the foam but proved not to be strong enough. After the winter freeze the ditch was restarted May-August, 1971, An electronic foam sensor was devised. When foam built up too much, the sensor caused the rotor to shutdown. A red warning lighted alerted farm personnel. The foam sensor, operating in conjunction with the head-box, completely eliminated foam spillovers. Little maintenance was required and the necessity of closely watching the foam was removed. (Merryman-East Central)

## 1306-A4, A6, B2, C1, C2, D3, E2, F3

### TREATMENT AND DISPOSAL OF SWINE WASTE

Greyhound Corporation.
T. J. Mulligan and J. C. Hesler.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 517-536. 8 fig. 4 tab.

Descriptors: *Waste treatment, *Waste disposal, *Farm wastes, *Hogs, Confinement pens, Feeds, Biochemical oxygen demand, Chemical oxygen demand, Foaming, Aerated lagoons, Anaerobic conditions, Odor.
Identifiers: *Swine Refeeding.

Several treatment systems for swine wastes are reviewed. Specific studies are cited and formulas derived. Anaerobic lagoons and aerated lagoons are found to reduce the organic contents of wastewater. Discharge of the treated settled effluent to surface waters after this type of treatment, however, is often unsatisfactory due to the nutrient content and color of the wastewater, Also, the remaining BOD, suspended solids, coliform, and salt content may be objectionable in certain receiving waters. Liquid wastewaters may be disposed of by spray irrigation or evaporation ponds. Each of these methods requires significant land area and may be accompanied by an odor problem. Wastes may be spread on the land or plowed and furrowed, but again there is a potential odor problem and large land area is required. Also in cold climates, the wastes would have to be stored until they could be deposited on the land. Wastes may be refed, but more research is needed. Many variables must be evalued in determining ultimate treatment and disposal of animal waste. Imaginative approaches to the overall waste problem are needed. (Merryman-East Central).

## 1307-A6, A8, B2, C3, D3, E2

### AEROBIC TREATMENT OF SWINE WASTE BY AERATOR- AGITATORS ("FUCHS")

Kiel University.
U. Riemann.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 537-544. 2 fig, 1 tab.

Descriptors: *Farm wastes, *Hogs, *Aerobic treatment, *Waste treatment, *Waste disposal, Odor Salmonella, Liquid wastes, Foaming.
Identifiers: *Swine, *Aerator-agitators, Liquid manure reactors.

Kiel Institute constructed an experimental plant consisting of 3 liquid manure reactors (each having a recirculating aerator), a pump sump pit, and an earth reservoir for evaporation and distribution of foam in order to investigate deodorization, biological disinfection, treatment, and disposal of pig manure through use of an aerobic treatment system. The pump sump pit received the liquid manure from the third reactor and the partially clarified liquid was distributed or directed to a storage tank. It was found that a nearly complete deodorization of fresh manure could be achieved after a daily refill or 3 $m_3$ fresh manure. Bacteriological investigations using salmonellae indicated that the bacteria were dead six hours after entering reactor at temperatures around 50°C. Sedimentation tests indicated that organic and inorganic flocculants have a positive effect on the separation process. Fertilization trials revealed (1) Aerated liquid manure is less corrosive than untreated manure to plants. (2) A total of 50m3/ha aerated liquid manure yields a 10% higher crop of summer barley than does the untreated. Fertilization of 150m3/ha of aerated liquid manure on sugar beets gave a slightly better result than the untreated fertilization. (3) Corn digests high liquid manure quantities. Further investigations are in progress. (Merryman-East Central).

## 1308-B2, B4, C2, D3

## NITROGEN LOSSES THROUGH DENITRIFICATION AND OTHER CHANGES IN CONTINUOUSLY AERATED POULTRY MANURE

Guelph University.
G. G. Dunn, and J. B. Robinson.
Waste Management Research, Proceedings of the 1973 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 545-554. 10 fig. 1 tab, 7 ref.

Descriptors: *Nitrogen, *Farm wastes, *Poultry, *Waste storage, *Waste treatment, Liquid wastes, *Oxidation lagoons Denitrification, Temperature, Biochemical oxygen demand, Chemical oxygen demand, Ontario.
Identifiers: *Manure, Organic loading, Loading rate, Total solids, Volatile solids.

The objectives of this study were to: (a) determine the effectiveness of pilot scale oxidation ditches in stabilizing the organic loading placed on them, and (b) determine the conditions of oxidation-reduction potential in the liquid waste under which nitrogen was eliminated. Two trials were conducted. The first lasted 138 days during winter (average ditch temperature 11°C) conditions. The second lasted 100 days under summer (average ditch temperature 18°C) conditions. Two ditches were used which had dividing partitions separating the rotor in the ditches from the birds. The rotor speed on Ditch II was fixed at 95 rpm. The rotor speed in Ditch I (which was variable) was set for the same ditch velocity. Forty-two cages housing 90-100 white leghorns were suspended over each ditch and the droppings fell directly into the ditch. The winter loading rate was 120 mg/litre/day of biochemical-oxygen demand and 375 mg/litre/day of chemical oxygen demand. The summer rate was 150 mg/litre/day of BOD and 500 mg/litre/day of COD. Experimental results indicated that the oxidation ditches used in this study were adequate for storing and treating liquid chicken manure in an odor-free condition for periods up to 100 days under the experimental loading conditions. At this loading rate, losses of 70-80% of the added nitrogen could be expected with little effect of temperature in the range 11°C-18° C. (Merryman-East Central).

## 1309-B2, C1, C2, D3

## SOLIDS BALANCE ON A BEEF CATTLE OXIDATION DITCH

Livestock Engineering and Farm Structures Research Branch, United States Department of Agriculture.
R. O. Hegg, and R. E. Larson.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 555-562. 3 fig. 4 tab, 7 ref.

Descriptors: *Farm wastes, *Cattle, *Oxidation lagoons Chemical oxygen demand, Biochemical oxygen demand, Hydrogen ion concentration, Liquid wastes, Minnesota.
Identifiers: *Solids balance, *Oxidation ditch, *Beef, Total solids, Total volatile solids.

The objective of this experiment was to determine the solids balance on a summer operation of an oxidation ditch for 36 beef animals which were fed a high concentrate ration. This oxidation ditch also included the removal of some of the settled solids during the experiment. The solids balance was made by comparing the total solids, total volatile solids, and fixed solids of the waste matter going into the ditch with material taken out of the ditch. Input consisted of the fecal matter (4.6 pounds dry matter per day) for each animal. The output consisted of the settled solids (partially digested corn) most of which were periodically removed during the experimental period for recycling. Total solids were reduced 30% and total volatile solids were relatively unchanged. (Merryman-East Central).

## 1310-B2, E1

## LAGOONS FOR MILKING CENTER WASTES

United States Department of Agriculture.
R. Crowe, and R. L. Phillips.
Waste Management Research, Proceedings of the 1972 Cornell Agriculture Waste Management Conference, Ithaca, New York, p. 563-567.

Descriptors: *Lagoons, *Dairy industry, *Farm wastes, *Waste storage, *Design criteria, Waste treatment, Cattle, Biochemical oxygen demand New York.
Identifiers: *Milking center wastes, *Soil Conservation Service, *Rural Economic Assistance Program.

Rural Environmental Assistance Program cost-sharing by the federal government has spurred many requests for assistance from the Soil Conservation Service in construction of lagoons for milking center wastes. A farmer who requests assistance is usually visited by the Cooperative Extension agent, SCS, and a representative of the health department. Location and practicality of the lagoon is influenced by (a) nearest residence, (b) prevailing wind direction, (c) general soils in the area, (d) type of outlet-gravity or pumping, (e) discharge point, (f) stream location, characteristics, and classification, (g) herd size—present and future, (h) present waste disposal system and (i) estimated cost of the lagoon. Lagoon layouts are designed with a surface area of 123 square feet per cow, are usually partially below and partially above the ground, and have a length to width ratio of 3:1. Rectangular shape is most economical. Maximum depth should be 5 feet and minimum 2 feet. The bottom should be level. Once the details are worked out, a cost estimate is made and the drawings and estimate are reviewed with the landowner for his concurrence and approval. The drawings and specifications, with a summary design report and application, are then submitted to the county health department for approval. (Merryman-East Central).

## 1311-A6, B2, B3, D1, D3, F1

## PILOT PLANT COMPARISON OF LIQUID AND DRY WASTE MANAGEMENT SYSTEMS FOR POULTRY MANURE

Cornell University.
D. C. Ludington; A. T. Sobel; R. C. Loehr; and A. G. Hashimoto.
Waste Management Research, Proceedings of the 1972 Cornell Agricultural Waste Management Conference, Ithaca, New York, p. 569-580. 2 fig. 4 tab, 6 ref.

Descriptors: *Farm wastes, *Liquid wastes, *Poultry, *Odor, *Oxidation lagoons, *Waste treatment, Air pollution.
Identifiers: *Waste management systems *Undercage drying-forced air, *Undercage drying-fins, *Diffused aeration.

Two primary waste management techniques are known to control the production of odors. The first is removal of moisture from manure soon after defecation. The second is to properly aerate a liquified manure and maintain the waste in an aerobic condition. Four different systems based on these two techniques were studied: (a) oxidation ditch, (b) undercage drying-forced air, (c) undercage drying-fins, and (d) diffused aeration. These experiments proved that properly aerating a liquefied manure and removing sufficient moisture from fresh manure will control odors in a poultry house. If a high degree of odor control is necessary, then the properly aerated liquid manure system would be the one to select. If the conditions are less severe, then undercage drying may accomplish sufficient odor control at a reduced operating cost. The losses of nitrogen for the various systems may or may not be an advantage depending upon the local situation and the point of ultimate disposal. The removal of volatile solids does permit operation at a lower total solids concentration with less dilution water. Specific trials and results are outlined and tabulated. (Merryman-East Central).

## 1312-A8, C2, C3

## USE OF CAISSONS FOR SAMPLING CHEMICAL AND BIOLOGICAL CONDITIONS BENEATH A BEEF FEEDLOT

Nebraska University, Lincoln.
L. F. Elliott; T. M. McCalla; N. P. Swanson; and F. G. Viets, Jr.
Transactions of the ASAE, Vol. 14, No. 6, p. 1018-1019, November-December, 1971. 4 fig. 2 tab, 3 ref.

Descriptors: *Feed lots, *Caissons, *Sampling, *Biological properties, *Soil chemical properties Surface-groundwater relationships, Soil contamination, Cattle, Soil gases.

The caisson installation allows soil gas and soil solution to be taken from the same sites, in the feedlot soil profile, over extended periods of time. These samples provide a measure of the chemistry and biological activity under a feedlot which would be extremely difficult without the benefit of the caisson installation. The sampling equipment required for this study is delicate and requires protection from the feedlot environment. To protect the instruments, large cylindrical compartments, or caissons, equipped with access ports, are inserted into the feedlot soil profile. Values obtained indicate the system will permit the measurement of the effect of feedlot management on the downward movement of pollutants. (Ballard-East Central).

## 1313-A10, A11, B1, D1

## MANURE IN PIT DRIES TO 15% MOISTURE

Poultry Extension
Tennessee University
Knoxville
Charles' H. Goan
Poultry Digest, Vol. 32, No. 381, p. 506-507, November, 1973. 1 fig.

Descriptors: *Farm wastes, *Moisture content, *Drying', *Poultry', *Waste storage, *Waste treatment Aeration, Ventilation, Air circulation, Tennessee.
*Manure, *Fans, *Deep-pit poultry house, Beetles, Marek's disease.

Manure in a high-rise or deep-pit poultry house in humid Robertson County, Tennessee, dries down to a moisture level of 15%. The 44x300-foot house has a capacity' for 30,000 layers and the pit area is approximately seven feet deep. The pit is ventilated by fourteen 48 inch fans located in the side of the wall of the manure storage area. An additional fourteen 30 inch fans are located in the pit itself. Aiding in the drying process, the burrowing action of beetles of the lesser mealworm leave small holes and tunnels in the manure which are believed to greatly increase the drying process. So far the beetles have caused no problems, but because the beetles may be potential carriers of Marek's disease, chickens should be obtained that have been vaccinated against this disease. (Ballard-East Central).

## 1314-A2, A8, A11, B1

### WASTE MANAGEMENT AND ANIMAL PERFORMANCE IN BEEF FEEDLOTS

Nebraska University
Nebraska Agricultural Experiment Station
Omaha
W. Woods; T. M. McCalla; C. B. Gilbertson; and J. R. Ellis.
Nebraska Beef Cattle Report, EC 72-218, p. 26-28, 1972. 2 fig, 2 tab.

Descriptors: *Feed lots, *Cattle, *Performance, *Control, Farm wastes, Density, Runoff, Consumption, Nebraska.
Identifiers: *Waste management, Slope.

At the University of Nebraska, a waste management research program was developed with these objectives: (1) to maintain or improve our environment, (2) to permit growth and development of livestock industry, and (3) to recognize that changes in animal agriculture must be economically sound. The research program measured characteristics of runoff from feedlots, percolation into the soil, and animal responses to lot surface conditions, animal density, and lot slope. At the Mead Field Laboratory, a comparison was made of 100 and 200 square feet per animal. One lot at each density was on 3, 6, and 9 percent slope. All cattle were fed the same ration to permit direct comparison of animal density and effect of slope of lot upon performance. Having cattle at 100 square feet per head reduced animal performance as compared to 200 square feet per head. At 200 square feet per head, lot surfaces were less than adequate and gains might be reduced. (Cameron-East Central).

## 1315-A11, B3

### EFFECT OF CONSUMPTION OF SHAVINGS ON HEMATOLOGY OF TURKEY POULTS

Division of Poultry Science, Georgia University, Athens.
K. W. Washburn and O. W. Charles.
Poultry Science, Vol. 52, No. 3, p. 1200-1201, May, 1973. 2 tab, 6 ref.

Descriptors: *Poultry, *Feeds, *Litter, *Diets.
Identifiers: *Wood shavings, *Hematology, *Turkey poults, Basal, Folic acid, Mean cell volume, erythrocyte count, Hemoglobin, Macrocytic anemia.

An experiment was designed to study the effect of the consumption of new wood shavings on the hematology of turkey poults. The experimental design consisted of four dietary treatments—(1) basal, (2) basal with wood shavings, (3) basal with added folic acid, and (4) basal with wood shavings and added folic acid. The shavings were fed from a feeder designed for determining individual feed efficiency. The average consumption of litter from those fed the basal diet was 291 grams, while those fed with folic acid added consumed 277 grams of shavings. The hematological parameters measured were: erythrocyte counts, mean cell volume, hemoglobin concentration, and mean cell hemoglobin concentration. No significant differences in the MCV or MCHC of any of the groups indicated that the shavings consumption did not affect the hematology of turkey poults, (Cameron-East Central).

## 1316-A11, B3, E3

### WASTELAGE—SOMETHING NEW IN CATTLE FEEDING

Department of Animal Science.
Auburn University.
Auburn, Alabama.
W. B. Anthony.
Highlights of Agricultural Research, Vol. 16, No. 2, Summer, 1969. 1 fig.

Descriptors: *Feeds, *Farm wastes, *Ruminant, *Recycling, *Microorganisms, *Digestion, Cattle, Sheep, Feed lots.
Identifiers: *Wastelage, *Waste management.

The value of wastelage, a feed made by combining manure with bermudagrass hay, was established in three feeding trials. In trial one, the wastelage-fed ewes were more vigorous and healthy than the hay-fed ewes. In trial two, the corn-silage fed heifers gained more weight while nursing calves than the wastelage-fed heifers. In trial three, wastelage fed steers made the best gain. Carcasses of both groups were equal. The cattle on the standard fattening ration suffered from rumen parakeratosis while none of the wastelage-corn steers had this disorder, (Drewry-East Central).

## 1317-A2, A10, B2, D1

### THE PERFORMANCE OF PRIMARY SETTLING ON LIVESTOCK FEEDLOT RUNOFF

Agricultural Engineering Department, Throckmorton Purdue Agricultural Center.
J. C. Nye; A. L. Sutton; and E. R. Baugh.
Presented at 1973 Annual Meeting, American Society of Agricultural Engineers, Paper No. 73-412, p. 7, June 17-20, 1973. 2 fig, 1 tab, 2 ref.

Descriptors: *Livestock, *Cattle, *Feed lots, *Farm wastes, *Waste treatment, Agricultural runoff, *Sedimentation, *Settling basins, Weirs, Indiana.
Identifiers: Porous dams, Fly breeding.

At Throckmorton Purdue Agricultural Center, primary sedimentation criteria were used to design a settling basin for runoff from a 200 head solid concrete beef feedlot. Sedimentation through the settling basin, consisting of three parallel chambers separated by porous dams provided for settling rates of 3, 5.5, and 11 cubic feet per hour per sq. feet of surface area for a 2-inch per hour rainfall intensity. Two problems were encountered — clogging of gravel dams, and fly breeding. A surface settling of 4 cu. ft./hr./sq. ft. and a weir loading rate of 100 cu. ft. per hr. per linear ft. were recommended as design criteria for feedlots of less than 300 head of cattle. A settling basin can be used in conjunction with lagoons in order to lower the lagoon loading. Porous dams may be eliminated by using liquid manure handling equipment to clean settling tanks. In some locations it may be possible to use this in conjunction with grass waterways and eliminate the need for lagoons or liquid handling equipment. (Drewry-East Central).

## 1318-B1, B4, C1, D1, F1

### MANAGING DEEP-PIT HOUSE TO REDUCE DRYING COSTS

Egg Industry, Vol. 6, No. 7, p. 31, 34, July, 1973. 2 tab.

Descriptors: *Farm wastes, *Poultry, *Drying, *Waste storage, *Costs, *Waste treatment, Temperature, Humidity Ventilation, Sampling, moisture content, Maine.
Identifiers: *Deep-pit poultry house, Pit, Dropping boards.

Research was done in Maine to try to reduce manure drying costs. The research was based on a study of four poultry farms, three brown-egg type houses, and one white egg. At each of the four farms, trials were run in winter, spring, and late summer. Manure samples were collected after one, two, and three-day accumulations—on both dropping boards and in the pit. Observations revealed that manure dried faster in the pit than on the boards after the first day. Manure dried to a lower moisture content during spring and summer in both pen and pit. The observations also indicated that under conditions normally present in Maine cage laying houses, the greatest amount of manure drying occurred the first day—regardless of location within the house. (Ballard-East Central).

## 1319-A4, A11, A12, B1, B5, C3, D3

### EFFECT OF TEMPERATURE AND AERATION ON THE SURVIVAL AND GROWTH OF SALMONELLA TYPHIMURIUM IN DAIRY WASTE

Auburn University, Alabama.
M. A. Jaleel.
M. S. Thesis, Auburn University, March, 1972. 78 p. 6 fig. 3 tab, 171 ref.

Descriptors: *Mortality, Dairy industry, Period of growth, Wastes, Coliforms, Cattle *Salmonella, *Temperature, *Aeration, Pathogenic bacteria, Epidemiology, Isolation, Separation techniques, Human diseases, Animal diseases, Carriers, Water pollution, Sampling, Cultures, Hydrogen ion concentration, Oxidation-reduction potentials, Farm wastes.
Identifiers: *Salmonella typhimurium, *Dairy wastes, Salmonella survival Detection procedure.

Dissemination of Salmonella typhimurium by dairy cattle leading to water contamination prompted study of the viability of this bacterium in liquid bovine waste. Salmonella detection and enumeration procedure of Cheng, et al. was modified by concentrating the enrichment medium rather than the inoculum. Confirmation of salmonella was accomplished by inoculating the suspected colonies from brilliant green agar into triple sugar iron agar. Serological confirmation was done by using polyvalent O antiserum. Results showed that S. typhimurium survived longer (mean survival time 44.4 days) at 10°C as compared to 3.4 days at 35C. A 99% kill of S. typhimurium in the aerated sample at 10°C was much faster (18-21 days) when compared to the 99% kill in the nonaerated sample at 10°C (28-35 days). Mean survival time in aerated dairy waste at 35°C was longer (16 days) than the mean survival time in the nonaerated sample (3.4 days). A 99% reduction of salmonella in aerated waste occurred during 12-18 days of incubation whereas in nonaerated waste 99% reduction occurred between 3 and 6 days of incubation. (Jones—Wisconsin)

## 1320-B2, C1, D1

### A ROTATING FLIGHTED CYLINDER TO SEPARATE MANURE SOLIDS FROM WATER

Agricultural Engineering Department, Oregon State University, Corvallis.
W. E. Verley, and J. R. Miner.
Presented at 1973 Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-410. 9 fig 3 tab, 6 ref.

Descriptors: *Farm wastes, *Slurries, *Water, *Waste treatment, *Waste disposal, *Sedimentation, *Separation techniques, Kinetics, Suspended solids, Oregon, Pumps, Weirs, Irrigation.
Identifiers: *Hydraulic manure transport systems, settleable solids, rotating flighted cylinder, concentrated solids, manure.

A rotating inclined tube, fitted with a helical fin on the inner surface was designed, built and tested to remove solids from liquid manure. Initially, a manure slurry of approximately 0.4 percent settleable solids was run through the device at 0.5 gallons per minute averaging a settleable solids removal of 30 percent. The design of the device was revised from 8 inches in diameter to a 24 inch diameter tube and was retested. The device offered an increased volumetric capacity, consumed little power, and was immune to plugging problems. The concept is simple and has potential applications wherever it is desired to concentrate solids or claim water for reuse. (Frantz-East Central).

## 1321-A6, B4, C1

### THE MAINE DEEP PIT CAGE LAYING HOUSE

Extension Agricultural Engineer, University of Maine, Orono.
C. W. Kitteridge.
Presented at the 1970 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 8-11, 1970, Paper No. 70-915. 8 p. 3 fig. 1 tab, 1 ref.

Descriptors: *Farm wastes, *Poultry, *Waste storage, *Maine, Costs, Moisture, Dehydration, Drainage, Fertilizers Confinement pens, Construction.
Identifiers: *Deep pit caged laying houses, Manure.

The deep pit caged laying house is a feasible method of poultry waste handling in northern climates. Wastes can be removed on a yearly or two-year basis. The wastes dry to an approximate moisture content of 30% and odors are practically all during the storage period. Excavation of the deep pit is about 8 feet. Proper drainage must be insured and basement walls and floors must be watertight. Deep pit caged laying houses are economical because of infrequent waste handling. These systems, when properly constructed and managed, have been successful in Maine. (Frantz-East Central).

### 1322-A8, C2, E2

### AMMONIA VOLATILIZATION AND NITROGEN TRANSFORMATIONS IN HIGH pH SOILS USED FOR BEEF MANURE DISPOSAL

U. S. Corps of Engineers, Vicksburg, Mississippi.
Robert E. Peters, and Donald L. Reddell.
Presented at the Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-428, 31 p. 8 fig. 9 tab.

Descriptors: *Ammonia, *Volatility, *Hydrogen ion concentration, *Nitrogen, *Soils, *Sampling Denitrification, Farm wastes, Cattle, Feed lots, Carbon dioxide, Lime, Chemical properties, Fertilizers, Texas.
Identifiers: *Nitrogen transfomations, *pH, Tabor loamy fine sand, Carbonates.

A study was conducted using 18 soil columns to study ammonia volatilization and nitrogen transformations in soils receiving manure applications. Three of both limed (pH=12.0) and unlimed (pH=7.5) soil columns were evaluated after 30, 60, and 90 day treatments. More NH3 was evolved from the limed soils than from the unlimed soils. CO2 production was greater in unlimed soils. Final chemical analyses of soils revealed 10% and 20% losses in nitrogen from limed and unlimed soils respectively. These nitrogen losses were greater in the upper 30 cm. of the soil columns. Nitrogen losses from the limed columns were believed to be by nitrification and then denitrification. (Frantz-East Central).

### 1323-A2, A11, B1, B4, C2, C3, D1, D3, E1, E2, F1, F2

### DAIRY HOUSING, NATIONAL DAIRY HOUSING CONFERENCE

Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, 469 p. 53 fig. 17 tab. 69 ref.

Descriptors: *Dairy industry, *Farm wastes, *Waste treatment, *Waste disposal, *Waste storage, *Environmental control, Legal aspects, Regulation, Air pollution, Water pollution, Economics.

Identifiers: *Free-stall housing, *Stall barns, Composting.
The National Dairy Housing Conference was an attempt to bring appropriate disciplines together to focus on the subject of dairy housing. Emphasis was on practical information for use by people in the field. Subjects included: free-stall housing, stall barns, herd health, environmental control, codes and regulations, milking systems planning, feeding systems, calf and young stock housing, milk house and milking parlor wastes, and manure management. (Janssen-East Central).

### 1324-A6, B2, B4

### CONVENTIONAL STALL BARNS WITH GUTTER GRATES AND LIQUID MANURE STORAGE

Agricultural Engineering Department, Minnesota University.
D. W. Bates.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 99-107. 5 fig. 5 ref.

Descriptors: *Waste storage, *Liquid wastes, *Dairy industry, Cattle, Ventilation, Odor, Minnesota.
Identifiers: *Stall barns, **Manure tanks, Gutter grates.

Dairymen in cold climates have begun to employ manure storage tanks 9 months of the year. For the new dairy barn, a practical place to store manure is directly beneath the barn for removal as a liquid. With this method, the wall of the manure tank can act as a foundation for the barn and the floor of the barn can serve as the cover for the manure tank. By using gutters with grated bottoms, manure and urine drop directly into the storage pits, and the need for a gutter cleaner is eliminated. A garden rake may be used to work through manure that hangs on the grates. Typical construction details for such a system are outlined. Already existing dairy barns usually have to employ an external manure tank. The gutter cleaner elevator can be modified so manure will drop directly into the tank. Careful planning and management is essential for the success of either system. (Janssen-East Central).

### 1325-A6, B1, F1

### SUMMER ENVIRONMENTAL MODIFICATION SYSTEMS FOR DAIRY COW HOUSING IN THE UNITED STATES

Agricultural Research Service, United States Department of Agriculture, Columbia, Missouri.
LeRoy Hahn, D. D. Osburn, and J. D. McQuigg.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 134-141. 3 fig. 12 ref.

Descriptors: *Dairy industry, *Environmental control, Productivity, United States, Odor, Moisture, Ammonia, Air Conditioning, Costs.
Identifiers: *Summer environmental modification systems, Housing, Evaporating cooling, Partial Air Conditioning.

Protective shelters for dairy cows are adequate in many areas of the United States, considering the normal levels of milk production and the relatively small regions of adverse summer climates. However, for high-producing cows in hot-dry or hot-humid climates, milk-production losses which are a result of the direct influence of climatic factors can be a severe problem. Managers of dairy herds in such areas should consider adopting an environmental modification system for improved production. The form of modification adopted must be rationally selected; not all systems are profitable. The optimum environment for maximum production is not the economic optimum for current costs and returns. Of the alternative systems considered in this report, evaporative cooling appears to have the most potential for application in areas with hot summer climates. (Hahn-ARS, USDA).

### 1326-A1, B1, E1, E2

### POTENTIAL ECONOMIC IMPACTS OF STATE POLLUTION CONTROL ON DAIRY FARMS

Agricultural Economic Department, Michigan State University.
L. J. Connor, and J. B. Johnson.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 182-191. 1 tab, 4 ref.

Descriptors: *Economic impact, *Legal aspects, *Dairy industry, *Farm wastes, *Waste treatment, *Waste disposal, Water pollution, Air pollution, Feed lots, Cattle, Michigan.
Identifiers: *State pollution controls, State statutes.

Changes in livestock production and concern for the environment have resulted in enactment of varied state statutes concerning pollution problems associated with livestock production facilities and waste disposal areas. The impact of state legal controls varies according to the type of legal control enacted, herd size, housing-waste handling systems, and specific location variables. A Michigan study illustrates the varying impacts upon dairy farms that would accrue with specific herd size and housing-waste handling systems for each of three selected legal pollution controls. Individual dairy farmers are advised to exercise caution in making any expansion or adjustments in their businesses, and in evaluating any potential environmental problems in their farms. (Janssen-East Central).

### 1327-B2, B4, D3, E1

### DESIGN OF MILKING CENTER WASTE MANAGEMENT SYSTEMS

Agricultural Engineering Department, Cornell University, Ithaca, New York.
R. T. Lorenson, and R. W. Guest.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 349-358. 2 fig, 1 tab, 11 ref.

Descriptors: *Dairy industry, *Design, *Farm wastes, *Waste treatment, *Waste disposal, *Waste storage, Lagoons, Biochemical oxygen demand, Septic tanks.
Identifiers: *Milking center, *Waste management systems, Aeration ponds, Effluent quantity, Settling tank.

Design data from several recent studies are applied to the collection, treatment, storage, and disposal systems for handling milking center wastes. Included are parameters for quantity, physical constituents, and biological degradation of milk room wastes, milking parlor wastes, and human wastes. Point source and composition of milking center effluent is outlined. Milking center effluent routing options are discussed. It is concluded that existing circumstances at the site must be that paramount consideration in selection of a waste handling option. (Janssen-East Central).

### 1328-A5, A6, B2, D1, D3, E2

### LAGOON DISPOSAL OF DAIRY WASTES IN FLORIDA

Agricultural Engineering Department, Florida University.
Dairy Housing & National Dairy House Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 359-370. 1 fig, 1 tab, 6 ref.

Descriptors: *Lagoon, *Farm wastes, *Waste disposal, *Waste storage, *Waste treatment, *Dairy industry, *Florida, Climates, Soil types, Water pollution, Odor, Sludge.
Identifiers: Sand trap, Anaerobic lagoon, Storage ponds, Dispersal field.

The dairy industry in Florida is characterized by large milking herds. The type of waste management systems used are influenced by the amount of labor and management input and by climate and soils of Florida. The most common waste management system used is the lagoon system, consisting of a sand trap, anaerobic lagoon, detention pond, and dispersal field. The dimensions, volumes, efficiency and maintenance requirements of each of the four major components of the lagoon systems are discussed. The Florida Department of Pollution Control has set guidelines for the use of lagoons in Florida and lagoon construction has accelerated in the state. The lagoon system is successful in Florida due to climatic and soil conditions but may not be successful in other states. Potential ground water pollution must be carefully considered. (Janssen-East Central).

### 1329-B2, B5, C1, C2, D3

### PROGRESS REPORT--AEROBIC AND ANAEROBIC LAGOONING OF DAIRY AND MILKING WASTES

Agricultural Engineering Department, Clemson University, Clemson, South Carolina.
C. L. Barth, H. P. Lynn, and W. L. Northern.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 371-380. 5 fig. 5 tab, 6 ref.

Descriptors: *Lagoons, *Aerobic conditions, *Anaerobic conditions, *Dairy industry, *Farm wastes, *Waste treatment, Sludge, Algae.
Identifiers: *Dairy wastes, *Milking wastes, *Lagoon simulators, Volatile solids.

A progress report was made on the lagooning of dairy wastes. One of the objectives was to evaluate the feasibility of the no-discharge, anaerobic lagoon as a treatment facility for all dairy production wastes in a warm climate. Results of various research reports are compared to results obtained through use of six lagoon simulators. Among the results were these: (1) Highest percent reductions of volatile solids were about 51% and 15% for the dairy manure wastes at the operating temperatures of 24.3°C and 11.5°C, respectively, (2) For the parlor wastes, maximum reduction percentages were about 63% and 10% at temperature levels of 24.6°C and 11.0°C. The increase of the higher over the lower operating temperature level approximates the rule of thumb that an increase of 10.°C in temperature doubles the biological activity rate, (3) No apparent difference existed in the rate of sludge buildup from the manure waste at the two operating temperatures, (4) Using the range of .135 to .18 ft. 3 of sludge per lb. of V.S. added and the figure of 7.9 lb. V. S./100 lb. cow/day would produce 390-520 ft. 3 of sludge per year, (5) It was found that each cow produced. six gallons of parlor waste, thus producing .025 to .05 ft. 3 of sludge per day of parlor wastes. (Janssen-East Central),

## 1330-A8, B2, E2

### IRRIGATION DISPOSAL OF MILKING CENTER WASTES

Agricultural Engineering Department, Missouri University, Columbia.
R. E. Phillips, M. R. Peterson, and R. M. George.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 381-388. 2 fig, 2 tab, 7 ref.

Descriptors: *Irrigation, *Waste treatment, *Waste storage, *Waste disposal, *Farm wastes, *Dairy industry, *Lagoons, Aerobic conditions, Anaerobic conditions, Water pollution.
Identifiers: *Milking Center, *Soil plant filter, Volatile solids.

The use of irrigation systems to distribute milking center wastes to a soil-plant filter is an effective method of both waste disposal and pollution prevention. An anaerobic lagoon is recommended for collecting and storing milking center wastes. The type of irrigation system selected should be based on size operation, soil type, terrain encountered on the soil plant filter, available capital, and the manager's preference. The four types of surface irrigation suited to disposal of liquid wastes are: controlled flooding, furrow irrigation, border irrigation, and corrugation irrigation. (Janssen-East Central).

## 1331-B2, B3, B4

### SOLID MANURE HANDLING FOR DAIRY CATTLE

Agricultural Engineering Department, Wisconsin University.
J. C. Converse, C. O. Cramer, T. J. Brevik, and O. H. Tenpas.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 389-397. 5 fig, 5 ref.

Descriptors: *Dairy industry, *Cattle, *Solid wastes, *Liquid wastes, *Farm wastes, Operations research management, Waste storage.
Identifiers: Manure stacking, Bunker, Manure.

Solid manure research activities, management techniques, and storage problems are discussed. Two types of storage facilities are described. One is a bunker type storage structure for solids with a detention pond for liquids. The other system consists of two storage units serving 28 and 26 cows each. One is a pivoting elevator which is an extension of the barn cleaner while the other one is a thrower which places the manure in a windrow. The liquids flow into detention ponds. Several field type units using low cost limestone or shale bases are also being investigated. Fifteen recommendations and conclusions were drawn from this research. (Janssen-East Central).

## 1332-A2, A5, B2, B3, B4, D1

### MANAGING BARNYARD RUNOFF FOR DAIRY CATTLE

Agricultural Engineering Department, Wisconsin University.
J. D. Converse, C. O. Cramer, T. J, Brevik, C. B. Gilbertson, G. H. Tenpas, and D. A. Schlough.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 398-403. 2 fig, 1 tab, 4 ref.

Descriptors: *Water storage, *Agricultural runoff, *Dairy industry, *Waste disposal, Cattle, Irrigation, Water pollution sources.
Identifiers: *Waste Management.

Runoff control facilities, installed at two Wisconsin farms, are described and the chemical and physical characteristics of the runoff are given. The three requirements for control of runoff are separation of solids, storage of runoff liquids, and a disposal area. Each of these farms utilized these requirements in similar manner, constructing a settling terrace, a settling basin, a porous dam, and a detention pond. Among conclusions and recommendations are the following: (1) Flow velocities in the terrace or basin should be less than 1 fps. with detention times greater than 1 hour. (2) The slope of the setling terrace must be essentially level to avoid a build-up of solids near the porous dam. (3) Removal of solids from the settling terrace soon after accumulation is necessary to maintain storage capacity for the next storm. (4) In Wisconsin, the capacity of the detention pond should be equal to 8 to 10 inches of runoff from the watershed because of winter precipitation. (5) Detention ponds should be located in impermeable soil so as to eliminate ground water pollution. (6) Detention pond slopes should be 3:1 to 6:1 with an 8 foot wide top on the berm. Ponds should be fenced for safety. (7) Just before freeze up in late fall, the liquid level in the detention pond should be lowered to provide storage for winter and early spring runoff. (Janssen-East Central).

## 1333-A2, A6, B2, B4, D1, E2

### AGITATING, PUMPING, AND INJECTING LIQUID MANURE

Director of Engineering, Starling, Inc., Harvard, Illinois.
A. K. Gillette.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 404-408.

Descriptors: *Waste disposal, *Liquid wastes, *Farm wastes, *Pumping, Waste storage.
Identifiers: *Agitating, *Manure, *Soil injection, Plowing, Disking, Agitator pump, Chopper pump, Vacuum pump, Centrifugal pump, Auger.

Manure collected and stored in pits or tanks usually must be agitated prior to emptying or pumping. This may be accomplished by use of an agitator pump, a "chopper" pump, or a vacuum type tank spreader. Each of these methods usually transports the liquid manure into a tank spreader used for depositing the manure onto the land's surface. The use of centrifugal pumps and augers is discussed but not encouraged. Soil injectors may be attached to the tank spreader, discharging the liquid manure into furrows and covering them up. Plowing and disking are discussed as means for obtaining similar results. Soil injection best achieves elimination of odor and runoff pollution. "Plowdown" rates next and disking rates last. All these methods are better than surface spreading for prevention of runoff and for odor control. (Janssen-East Central).

## 1334-A6, B2, B4, C1, C2, D1

### MIXING AND HANDLING OF LIQUID DAIRY CATTLE MANURE

School of Engineering, Guelph University, Guelph, Ontario.
J. Pos, and H. E. Bellman.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, Febuary 6-8, 1973, p. 409-418. 1 tab.

Descriptors: *Dairy industry, *Farm wastes, *Waste storage, *Aerobic treatment, *Liquid wastes, Nitrogen, Chemical oxygen demand, Biochemical oxygen demand, Mixing, Handling, Slurries, Odor, Ontario.
Identifiers: Manure pump, Agitation, Total solids,

A largely unsuccessful attempt was made in Ontario to evaluate several methods of agitating large quantities of liquid dairy manure and to investigate several possibilities of aerobic treatment to control odours in storage. The basic plan was to use 4 pipelines to each of 3 storage tanks; 3 for pumping manure into the bottom of each tank and a return line to the sump. Stones and wood shavings got into the system creating blockage problems. Another time, a four inch plastic pipe burst emptying the liquid manure into the barn and into a highway ditch. During the winter the agitator pump froze up. Data recorded December, 1972—January, 1973 revealed daily production of diluted manure for 104 dairy cows to be 225 cu. ft. of manure slurry and 108 cu. ft. wash water from the milk room and milking parlour. Eventually the amount of wash water was reduced, but the total diluted manure production of 3.19 cu. ft.. per cow still exceeded the design specifications of 2 cu. ft. per cow. Analyses during this time for NH4, Org. N, Total N, BOD, and COD were made. In January of 1973, the tank had 20,474 cu. ft. of manure with a 4-inch thickness of frozen manure on the surface. On the basis of total solids and content, it appeared that a reasonable mix of suspended solids below the frozen crust was obtained after 30 minutes of mixing. Further observations and analyses are continuing to be made. (Janssen-East Central).

## 1335-B2, C1, C2, D1

### FLUSHING SYSTEMS FOR FREE-STALL DAIRY BARNS

Agricultural Engineering Department, Ohio State University.
R. K. White, and R. M. Porter.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 419-428. 7 fig, 3 tab.

Descriptors: *Farm wastes, *Dairy industry, Automation, Chemical oxygen demand, Biochemical oxygen demand.
Identifiers: *Flushing systems, Free-stall dairy barns, Total solids, Volatile solids.

A new dairy science center was installed at the College of Agriculture at the Ohio State University with a flushing system for manure handling. A description of the facility is given. Two nine hundred gallon tanks with vertical sluice gates were used to discharge the flushing water. Peanut hulls were substituted for straw as bedding to allow the manure slurry to be discharged into the Columbus sewer system. Characteristics of the manure slurry, estimated daily water use, and manure output are tabulated. The flushing system will allow automation of a dairy facility and will reduce labor costs. (Janssen-East Central).

## 1336-A4, B2, B3, B4, D1, D2, D3, E1, E2, E3

### LIQUID COMPOSTING OF DAIRY COW WASTE

Director of Research, The DeLaval Separator Co., Poughkeepsie, NY.
Bernard Hoffman, and Lois S. Crauer.
Dairy Housing, National Diary Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 429-440. 4 fig.

Descriptors: *Farm wastes, *Dairy industry, *Cattle, *Waste treatment, *Waste disposal, *Wastewater treatment, Water pollution, Aerobic bacteria, Thermophilic, Ammonia, Biochemical oxygen demand, Chemical oxygen demand.
Identifiers: *Composting, *Liquid wastes, *Licom System.

Surface water and groundwater can be contaminated by manure through runoff and infiltration. A liquid composting system (Licom), developed by The De Laval Separator Company, deodorizes, pasteurizes, and biologically decomposes dairy cattle wastes with the use of digestion tanks and bacteria. Several modes of Licom System operation are available. Effluent from Licom I is completely stabilized and pasteurized and can be stored for long periods isbefore returning it to the land. The Licom II is a continuous system and operates more efficiently than Licom I. Licom III is also a continuous system and offers a method of separating the liquid and solid waste for discharge of the liquid into surface waters. The Licom III method efficiently met the New York State standards for effluent released into surface waters. The dry residue from Licom III may be used as a soil conditioner or as bedding in the barns. (Janssen-East Central).

## 1337-B3, D3

### SOLID COMPOSTING OF DAIRY MANURE

Agricultural Research Service, United States Department of Agriculture.
G. B. Willson, and J. W. Hummel.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 441-459. 12 fig, 2 tab, 9 ref.

Descriptors: *Dairy industry, *Farm wastes, Aeration, Moisture, Chemical oxygen demand, Aerobic bacteria, Nitrates, Ammonia, Permeability, Thermophilic bacteria.
Identifiers: *Compostiong, *Manure.

This paper is based on studies that were undertaken to develop design criteria for composting operations. Aeration data was obtained from tests in small bench composters, and in one-half ton capacity bins. These data were substantiated by the composting of dairy manure in a mechanized channel. It was determined that ideally the aeration rate would be varied during the process in the following sequence: 1. During the warmup stage of the process, aeration would be applied at increasing rates in the low part of the temperature limiting range. 2. When thermophilic temperature is reached, the aeration rate would be increased to the top of the temperature limiting range. If some drying is desirable, a higher aeration rate would be selected. 3. As the level of activity decreases, the rate of aeration would be reduced to prevent cooling. This operating procedure will keep temperatures up until desired degree of decomposition is reached. (Janssen-East Central).

## 1338-A4, B2, F2, F4

### WASTE MANAGEMENT REGULATIONS AND PROPOSALS

Agricultural Pollution Control Research Program, Office of Research and Monitoring, United States Environmental Protection Agency, Washington, D. C.
W. C. LaVeille.
Dairy Housing, National Dairy Housing Conference, Michigan State University, East Lansing, February 6-8, 1973, p. 460-469.

Descriptors: *Federal Water Pollution Control Act, *Farm wastes, *Feed lots, *Regulation, *Legal aspects, Environmental control, Water pollution sources, Permits, Cattle, Hogs, Poultry.
Identifiers: *Waste management, Environmental Protection Agency.

The establishment, organization, and activities of the Environmental Protection Agency are discussed. The history of federal water pollution control is traced from the 1886 River and Harbor Act to the Federal Water Pollution Control Act of 1972. It is felt that this new law will bring a profound and far-reaching change in the system of pollution control because it (1) establishes effluent limitations, (2) establishes higher standards of pollution control, (3) creates a national permit program and (4) establishes tough penalties to enforce compliance. The most immediate concern of those involved in agricultural production activities is how the permit program will affect them. Proposed rulemaking excludes discharges from agricultural and silvicultural activities from NPDES (National Pollutant Discharge Elimination System) requirements with the exception of large feedlots, certain types of hatcheries and fish farms, and return flow from some medium- and large-sized irrigation systems. Although owners and operators of the excluded point sources are not required to obtain an NPDES permit, they must comply with the other requirements of the Act, including any applicable effluent guidelines, standards of performence, toxic effluent standards or prohibitions; or pretreatment standards. (Janssen-East Central).

## 1339-B1

### CLIMATE AND THE SELECTION OF A BEEF HOUSING AND WASTE MANAGEMENT SYSTEM

Agricultural Engineering Department, Oklahoma State University, Stillwater.
A. F. Butchbaker, G. W. A. Mahoney, and J. E. Garton.
Transactions of the ASAE, Vol. 16, No. 4, p. 734-739, July-Aug., 1973. 5 fig, 1 tab.

Descriptors: *Climate, *Climatic data, *Climatic zones, *Feed lots, Farm Wastes, Waste treatment, Waste disposal, Cattle, Temperature, Moisture.
Identifiers: *Beef housing, *Location, Climatological maps.

Location of a beef feedlot is influenced by factors related to economics, local topography, nearness to residential areas, soil type, roads, microclimate, streams or lakes, area for waste disposal, and climatic conditions. This report is concerned with climate, one of the major considerations in determining a feedlot location because climate influences both capital investment and operating cost. Some of the climatic factors affecting waste management systems are those that also affect animal performance. These include temperature, humidity, solar radiation, wind, evaporation, precipitation, sunshine, and storms. These topics are explained. Beef housing climatic zones were developed by using air temperature, evaporation and precipitation. Another method of classifying beef housing and waste management systems is to develop a climatological map utilizing mean annual air temperature and moisture deficit. These climatological maps may be used to select a general waste management system. The waste management systems in the various climatological areas should be considered as those that are optimum for that area. (Cartmell-East Central).

## 1340-A2, A4, A5, A6, B2, B3, E1, E2, E3, F2

### FEEDLOT WASTE MANAGEMENT: PROGRESS AND OUTLOOK

Agricultural engineer—animal waste management, Texas Agricultural Extension Service, Department of Agricultural Engineering, Texas A & M University.
J. M. Sweeten.
Texas Agricultural Progress, Vol. 19, No. 2, p. 18-19, Spring, 1973.

Descriptors: *Waste disposal, *Waste treatment, *Feed lots, *Pollution abatement, *Farm wastes, *Water pollution control, Solid wastes, Odor, Recycling, Irrigation, Fertilization, Rainfall, Solid wastes, Regulation.
Identifiers: *Waste management, refeeding, Pyrolysis, Odor intensities, Climatic variables.

Water pollution abatement was an environmental pollution problem for Texas cattle feeders. The Texas Water Quality Board restricts seepage to ground water and forbids discharges of feedlot runoff from rainfall. To prevent this seepage, diversion channels, retention ponds and irrigation systems are constructed near playa lakes. Texas standards for feedlots may serve as a model for forthcoming federal water pollution limitations. Another environmental problem is the large number of manure stockpiles. These wastes are being disposed of by farmers interested in increased profits from crop production. Research of the USDA at Bushland, Texas, shows that 10-ton-per-acre applications of feedlot manure matched nitrogen-phosphorous-potassium fertilization in production of grain sorghum. Test results indicate that feedlot manure can be safely and economically applied at 10 tons per acre per year under many soil and cropping conditions. Besides land disposal, recycling methods involve converting animal wastes into animal feed, fuels, building materials and other products. Solutions to feedlot odor problems need to be developed. Odor intensities, climatic variables, and waste management practices need to be understood before this can be done. When these pollution problems have been solved, feedlot waste management may involve economic alternatives rather than being primarily involved with pollution abatement. (Cameron-East Central).

## 1341-A6, B2, D1, E2

### NO ODOR AND NO POLLUTION

Soil Conservation Service, Hondo, Texas.
E. L. Abbott.
Soil Conservation, Vol. 39, No. 2, p. 8-9, September, 1973. 2 fig.

Descriptors: *Odor, *Recycling, *Farm wastes, *Feed lots, Irrigation, Air pollution, Water pollution, Texas.
Identifiers: *Feeding pens, *Slatted floor, Bermudagrass, Detention pit, Concrete tile line.

Near Devine, Texas, is a cattle feedlot which has a total recycling system for feedlot wastes. Feeding pens, designed so that all waste material on the floor drains downward, are all concrete with half the area of each pen under roof. Floors are flushed at regular intervals causing waste material to drain into a concrete tile line which carries it into a two-compartment concrete detention pit. There, quantities of clear water are added to the slurry. The liquid is lifted by a pump and flows under pressure through an underground pipeline to pivoting irrigation booms which sprinkle the "brown water" on the soil of mowed fields. A second concrete pit provides an overflow catch basin which assures no escape of waste material. Coastal bermudagrass is the best grass for this type of fertilizer-irrigation. The grass goes through a dehydration process before it is pelleted to be fed to the cattle. This type of feedlot has been designed and tested to be sure that pollution was a thing of the past. This particular feedlot has won many awards for its success. (Cameron-East Central).

## 1342-B2, B3, B5, C1, C2, D1, D3, E3

### CONCENTRATION OF PROTEINACEOUS SOLIDS FROM AERATED SWINE MANURE

University of Briitsh Columbia, Canada.
Lloyd W. J. Holmes.
MS Thesis, Agricultural Engineering Department, University of Illinois, 1971, 92 p.

Descriptors: *Farm wastes, *Hogs, *Aeration, *Oxidation lagoons, *Recycling, Suspended solids, Sieves, Centrifugation, Amino acids, Proteins.
Identifiers: *Manure, *Refeeding, Proteinaceous solids, Oxidation ditch mixed liquor.

This study was undertaken to determine what fraction of swine oxidation ditch mixed-liquor (ODML) possessed a refeeding potential; and to determine the best method of recovery and concentration of this fraction. Swine ODML samples were passed through a series of sieves, ranging in size from 20-to- 200-mesh. The solids retained on each screen were dried, weighed and analyzed for kjeldahl nitrogen. It was apparent that the highest crude protein and largest weight fraction was contained in the smallest size fraction, those suspended solids passing through a 200-mesh sieve. Preliminary investigations indicated that centrifugation was a promising method of ODML S.S. concentration. Centrifuging trials were run on screened ODML to determine the optimum feed rate and G force required to produce a concentrated cake of approximately 6-8 percent solids dry weight basis (dwb). Increasing the feed S.S. concentration had the effect of decreasing S.S. recovery. Centrifuged samples of swine ODML were found to contain a greater percentage of essential amino acids than corn. Centrifugation has been shown to be a feasible method of concentrating the amino acid-rich portion of swine ODML. Liquid volume reduction on the order of 85 percent can be achieved by increasing the solids content of ODML from 1.2 to 8 percent. This solids concentration is sufficient to enable researchers to refeed a substantial amount of swine ODML S.S. without including the bulk of the carrier liquid in the feed. (Cartmell-East Central).

### 1343-B3, D2, E3, F1

### CATTLE MANURE TO PIPELINE GAS

Pittsburgh Energy Research Center, Bureau of Mines, Pittsburgh, Pennsylvania.
Herman F. Feldmann, K. Kiang, C. Y. Wen, and P. M. Yavorsky.
Mechanical Engineering, October, 1973, p. 36-41. 1 fig, 4 tab, 6 ref.

Descriptors: *Cattle, *Farm wastes, *Recycling, solid wastes, Organic wastes, Methane, Moisture, Economics.
Identifiers: *Manure, *Gas, Hydrogasification, Hydrant process.

This is an experimental study in which dried cow manure was reacted with hydrogen under a variety of conditions to determine the yield of hydrogasificatiaon products. Demonstrated is the feasibility of converting manure to pipeline gas on a large scale. For reasonably large plants, the pipeline gas from this process is is cheaper than from any other source except natural gas. The primary reason for these favorable economics is that manure is assumed to be free. Because of the important effect of plant size on gas price, more detailed estimates will be made of smaller plants to determine the minimum feasible plant size and thereby determine the areas of the country where application of this technology would be economically feasible. (Cartmell-East Central).

### 1344-A4, A11, C3

### BACTERIAL POLLUTION INDICATORS IN THE INTESTINAL TRACT OF FRESHWATER FISH

Microbiology Section, Basic and Applied Science Branch, Division of Water Supply and Pollution Control, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
Applied Microbiology, Vol. 14, No. 3, p. 429-437, May, 1966. 2 fig., 7 tab, 19 ref.

Descriptors: **Bacteria, *Freshwater Fish, Coliform, Sampling, Temperature.
Identifiers: *Bacterial pollution indicators, *Intestinal tract, Fecal coliforms, Streptococci, Little Miami River.

A study was made of the occurence, distribution, and persistence of coliforms, fecal coliforms, and fecal streptococci in the intestinal tract of freshwater fish. A total of 132 fish representing 14 different spcies were used in various phases of these experiments. Examination of the intestinal contents of 73 fish from moderately polluted sections of the Little Miami River indicated that fecal coliform densities were lowest in bluegills and highest in catfish. Levels of fecal streptococci for these two species were 220 and 240,000 per gram, respectively. The occurrence of fecal coliforms in fish caught in this stream reflected the warm-blooded-animal-pollution level of the water. All fish used in this phase of the study were caught during July, August, and September when the water temperatures were between 13 and 18 C. The fate of fecal coliforms and streptococcus faecalis in the fish intestine indicated that these organisms can probably survive and multiply when fish and water temperatures are 20 C or higher, but only when the organisms are retained in the gut for periods beyond 24 hr. (Cartmell-East Central).

### 1345-A11,B1, F1

### ARIZONA OPERATORS QUESTION FLUME CONCEPT

Editor of BEEF.
Paul D. Andre.
BEEF, Vol. 10, No. 6, p. 44, February, 1974. 2 fig.

Descriptors: *Waste disposal, *Flumes, *Feed lots, *Cattle, *Farm wastes, Design, Ammonia, Costs.
Identifiers: *Waste management, Slotted floors, Flushing.

This was a test of a flume structure in Arizona. The test building was 24 feet wide and 400 feet long with two 12 inch flumes on 12 foot centers. Various textures were used on the floor surface, and the slope of the flumes ranged from ½ inch to 1 inch per foot. During the feeding test, 30 head of cattle were placed in each pen. An equal number of comparable cattle were put in an adjacent slotted floor building and given the same amount of space per head. Rations were identical. The following problems arose with use of the flume structure: (1) insufficent cleaning, (2) difficulty of the men in maintaining their balance, (3) the need for daily flushing, (4) the need for the cattle to have shade, (5) lack of ammonia control, and (6) the difficulty of cattle in getting their footing. There was no significant difference in the performance of the groups of cattle and no significant difference in the operating costs of the two operations. (Cartmell-East Central).

### 1346-B2, F1, F2

### FEEDLOTS POINT SOURCE CATEGORY: EFFLUENT GUIDELINES AND STANDARDS PART II.

Environmental Protection Agency.
Federal Register, Vol. 39, No. 32, February 14, 1974, p. 5706-5707.

Descriptors: *Feed lots, *Livestock, *Poultry, *Hogs, *Effluent,, *Farm wastes, Technology, Economics, Dairy industry.
Identitfiers: *Standards, Open lot, Housed lot, Stall barn, Free stall barn, Milkroom, Milking center, Process waste water, Process generated waste water.

Environmental Protection Agency guidelines and standards involving feedlots and waste production are presented. The terms feedlot, process waste water, process generated waste water, 10 year —24 hour rainfall event, 25 year—24 hour rainfall event, open lot, housed lot, stall barn, free stall barn, milkroom, and milking center are defined. Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available are presented. Also effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable is discussed. Pretreatment standards for existing sources, standards for performance for new sources, and pretreatment standards for new sources of waste are also considered. (Russell-East Central).

### 1347-A4, A11, C3

### THE BACTERIAL FLORA OF THE ATLANTIC SALMON (SALMO SALAR L.) IN RELATION TO ITS ENVIRONMENT

Department of Trade and Industry, Torry Research Station, 135 Abbey Road, Torry, Aberdeen, Scotland.
R. W. Horsley.
The Journal of Applied Bacteriology, Vol. 36, No. 3, p. 377-386, September, 1973. 4 fig, 3 tab, 29 ref.

Descriptors: *Salmon, *Environment, Sampling.
Identifiers: *Bacterial flora, Skin, Gills.

The aerobic flora of the skin of 56 Atlantic salmon from coastal, estuarine and river water was analyzed quantitatively; 50 skin and 33 gill samples were analyzed qualitatively. The water at each sampling station was also analyzed. The principal genera on the skin and gills were Moraxella, Flavobacterium, Cyptophage and Pseudomonas; members of Acinetobacter, Bacillius, Aeromonas, Vibrio, the Entrobacteriaceae, Micrococcaeae and some coryneforms were also present. These analyses indicated that the flora of fish is a reflection of their environment. (Cartmell-East Central).

### 1348-B3, D2, E3

### BRICKS ARE BEING FORMED FROM MANURE AND GLASS

Hoard's Dairyman, Vol. 119, No. 1, p. 35, January 10, 1974.

Descriptors: *Farm wastes, *Cattle, *Recycling, *Waste disposal, Dairy industry.
Identifiers: *Glass, *Bricks, *Manure, *Building materials.

Dr. John D. Mackenzie, Los Angeles engineering professor, has perhaps found an answer to the problem of animal waste disposal. He has perfected building products, such as bricks, tiles, wall core materials, and garden stones, from a mixture of dried cow manure and broken glass bottles blended together in a pressure cooker. The building products are stronger and lighter than any now on the market. They are fireproof, odorless, noise and heat insulators, and can be drilled, sawed, painted and glued easily. This inexpensive process answers two problems: (1) environmental concerns on the farm, and (2) badly needed construction materials. It also utilizes the untold amounts of disposable glass containers. The University of California has applied for patents covering the main process. (Cameron-East Central).

### 1349-A2, A4, B2, B3, F3, F6

### ANIMAL FEEDLOT WASTE RESEARCH PROGRAM

Treatment and Control Research Program, Robert S. Kerr Research Center, Environmental Protection Agency, Ada, Oklahoma.
Jack L. Witherow, Marion R. Scalf, and Lynn R. Shuyler.
Unpublished paper, April, 1971. 21 p. 1 fig, 9 ref.

Descriptors: *Confinement pens, *Water pollution sources, *Farm wastes, Surface runoff, slurries, livestock, research and development, projects, feed lots.
Identifiers: Manure.

The growth and cause of water pollution from animal feedlot waste is described. The research responsibilities of the Federal Water Pollution Control Administration are met by inhouse, grant and contract projects. Priority for research projects is given in terms of immediate and long range research needs. A list of immediate research needs is grouped into specific characterization projects and specific soil treatment projects. The long range research need for prevention of water pollution is described for liquid runoff, solid manure, and slurry systems. Seven specific project areas are presented in a list. One figure presents pollution control pathways for the three forms of animal wastes. (FWPCA Abstract).

## 1350-A4, B2, B4, D1
### CONFINEMENT SYSTEM OFFERS NEW SOLUTIONS TO OLD PROBLEMS
Staff editor of FEEDLOT MANAGEMENT.
Torr. Zurowski.
FEEDLOT MANAGEMENT, Vol. 15, No. 9, p. 44, 48, September, 1973. 2 fig.

Descriptors: *Farm wastes, *Feed lots, *Confinement pens, *Livestock, *Farm management, *Waste storage, Waste treatment, Costs.
Identifiers: Concrete holding ponds, Barn cleaners, Hot water heating system, Slatted floors, Pollution.

Cliff Nybo and John Nilander built a workable confinement system in Northfield, Minnesota. The system is composed of a confinement barn, a concrete holding pond, barn cleaners, and a special hot water heating system in the floor of the unit which helps make the entire system functional. The barn is divided into 8 pens. Each pen has a capacity for 75 animals with approximately 20 sq. ft. of space per animal. The floor is partially slatted. A steeply sloped pit is located beneath the slatted area. Barn cleaners are at the bottom of the pit. The cleaners dump the manure into a concrete holding pond. To prevent manure freeze up, hot water heating lines are placed beneath the solid portions of the floor. The system, not including cleaners, feed storage, feeders, and waterers, cost $74,000. The advantages of this system are that it is pollution proof and it is easy to operate. Because it has zero discharge from its pens, this operation will comply when any new pollution control regulations are developed. (Cameron-East Central).

## 1351-A4, A5, A7, A8, E3
### SYMPOSIUM: PROCESSING AGRICULTURAL AND MUNICIPAL WASTES
G. E. Inglett, editor.
Symposium: Processing Agricultural and Municipal Wastes, New York, New York, August 27-28, 1972, 221 p. 90 fig, 65 tab, 301 ref.

Descriptors: *Research aand development, *Waste treatment, *Recycling, *Waste disposal, *Farm wastes, Municipal wastes, Industrial wastes, Water pollution, Air pollution, Soil contamination, Environmental control.

To meet the needs of the increasing world population, cities become larger, industries expand, and agricultural operations become larger and more automated. All of these necessary increases in production result in a simultaneous increase in waste production and the problem of adequately dealing with this waste broadens. The papers of this symposium indicate that this problem is being met head-on, and technology is being devised, tested, and re-examined to deal with the waste problem. Advances in recycling animal, poultry, and industrial wastes have been recorded, but much more has been shown to be necessary. Various methods for utilization of these by-products have been outlined and offer very promising results. With the beginnings offered at this symposium, there is little doubt that the challenge of progress and increased production in our society can be dealt with efficiently and economically. (Russell-East Central),

## 1352-F4
### THE CHALLENGE OF WASTE UTILIZATION
G. E. Inglett.
Symposium: Processing Agricultural and Municipal Wastes, New York, New York, August 27-28, 1972, p. 1-5. 3 tab, 8 ref.

Descriptors: *Farm wastes, *Municipal wastes, *Livestock, *Waste treatment, *Waste disposal, Agricultural wastes, Industrial wastes, Technology, Environmental control.
Identifiers: *Waste management *Processing, *Waste utilization, Meat consumption, Composting.

Large concentrations of people, animals, and manufactured goods create waste problems. In 1965, 575 billion pounds of solid waste were produced for disposal. Of this total, industrial waste accounted for 229 billion pounds. This leaves 60% of the total waste production to come from agricultural waste. Concentration of animal waste is highly dependent on the present trends of automation and centralization. In cattle, swine, dairy herds, and poultry, feedlots are becoming larger and fewer, thus causing greater waste problems. Increasing consumption of meat with concomitant population growth can predictably bring more agricultural waste. For each pound of beef produced, 25 pounds of manure are produced. Thus, by 1980, 470 million tons of cattle manure will be produced for the estimated 235 million beef consumers in the United States. There is an immediate need for more technology for developing systems for waste management and utilization. Some of the proposed processes and related technology in this symposium may fill this need. (Russel-East Central).

## 1353-B1, E3, F1
### ECONOMIC ISSUES IN MANAGEMENT AND UTILIZATION OF WASTE
Alden C. Manchester, and J. G. Vertrees.
Symposium: Processing Agricultural and Municipal Wastes, New York, New York, August 27-28 1972, p. 6-12. 6 ref.

Descriptors: *Economic, *Waste treatment, *Recycling, Poultry, Livestock.
Identifiers: *Waste management, *Waste utilization, Public policy, Government cost-sharing.

There is no universal solution to waste management problems. Alternative waste management methods exist for most firms, creating a need for economic analysis to determine the least-cost solution. The economic choice is between waste treatment and waste utilization. Utilization offers more long term promise; but before launching large projects, an analysis of waste utilization should be undertaken. In determining economic feasibility of utilization, three factors should be considered: (1) the market potential of waste utilization products; (2) the cost of such a process; and (3) the cost of waste management alternatives. The potential for increased utilization of waste is dependent on public policy toward utilization and on equity. Government cost-sharing may stimulate industries into using wastes, and even without significant aid or price change, many firms will utilize waste from their operations as a least-cost means of waste management when the costs of alternatives are evaluated. (Russell-East Central).

## 1354-B1, D1, D3, E3, F1
### PROCESSING ANIMAL WASTES FOR FEED AND INDUSTRIAL PRODUCTS
J. H. Sloneker, R. W. Jones, H. L. Griffin, K. Eskins, B. L. Bucher aand G. E. Inglett.
Symposium: Processing Agricultural and Municipal Waste, New York, New York, August 27-28, 1972, p. 13-28. 1 fig, 8 tab, 20 ref.

Descriptors: *Farm wastes, *Recycling, *Feeds, *Waste treatment, *Waste disposal, Nitrogen, Amino acids, Fermentation, Organic matter, Enzymes, Proteins.
Identifiers: *Processing, *Feed products, *Industrial products, Feedlot waste fractionation, Hardboard.

Reprocessing animal waste offers promising possibilities for elimination of a huge waste management problem. The average feeder steer generates 2.2 pounds of protein per day. If processed, a feed of manure has a value comparable to soybean meal and is worth about $20 per ton more than the cost of recovery. By a simple screening process, approximately 70% of the total nitrogen can be recovered from feedlot waste as a potential feed fraction containing 35-40% protein and representing approximately 40% of the total waste solids. The remaining bulky fiber fraction can be converted into a cheap, nonodorous ingredient for fiberboard-like products. Alternatively the fiber fraction and solubles can be recombined and used as a fermentation substrate for the cellulolytic fungus, T. viride. Studies with whole manure and the fibrous fraction indicate that more than 25% of the organic matter is digested by the fungus with complete retention of the nitrogen. These data illustrate that, potentially, T. viride enzymes, as an additive, can increase the digestibility and metabolizable energy of feeds. (Russell-East Central).

## 1355-B1, D3, E3, F1
### PROCESSING ANIMAL WASTE BY ANAEROBIC FERMENTATION
W. B. Coe, and M. Turk.
Symposium: Processing Agricultural and Municipal Wastes, New York, New York, August 27-28, 1972, p. 29-37. 1 fig, 1 tab.

Descriptors: *Recycling, *Farm wastes, *Fermentation, *Anaerobic conditions, Aerobic conditions, Waste treatment, Feed lots, Chemical analysis, Economics, Ammonia, Cattle.
Identifiers: *Processing, Refeeding.

Wastes must be recycled into products which can be used by the producer of these wastes. The recycling must be conducted in a non-polluting and profitable manner. The most desirable recyling product is a feed ingredient. The two major systems for degradation of manure utilize microbial conversion and consist of aerobic processes. Recent efforts have been directed toward aerobic techniques, but these processes have proved to be costly. The anaerobic process is technically and economically the most attractive method of recycling animal wastes. This process produces two products (a feed ingredient and a fuel in the form of methane) useful to the animal feeder. It accepts all the wastes produced without pollutional discharges and is potentially profitable. The anaerobic process requires two-thirds the capital investment and one-half the annual operating expense of the aerobic process. (Russell-East Central).

## 1356-A11, D1, D2, F1
### AGRICULTURAL CELLULOSIC WASTES FOR FEED
Terry Klopfenstein, and Walter Kaers.
Symposium: Processing Agricultural and Municipal Wastes, New York, New York, August 27-28, 1972, pp. 38-54. 13 tab, 33 ref.

Descriptors: *Farm wastes, *Feeds, *Cellulose, *Waste treatment, Performance, Livestock, Silage, Inhibitors, Alkalinity.
Identifiers: *Sodium hydroxide, Digestibility, Roughage.

Agricultural cellulose wastes such as crop residues, fecal matter, paper, wood by-products and similar materials represent a vast supply of poorly utilized energy. Ruminants possess a unique digestive system which enables them to partially utilize the carbohydrate fraction of these materials. There are two procedures for enhancement of cellulosic waste usage. The first is the addition of sodium hydroxide to low-quality roughage followed by ensiling. At the present time, this appears to have practical applications, although the mechanics of collecting these low quality roughages and addition of sodium hydroxide and water would appear to be the greatest problems. The second procedure utilizes high pressure and temperature treatment of forages. To be practical and economical, this procedure would require on operation where materials could be collected and treated at a large centrally located facility. However, with treatment of large quantities, the cost could probably be held within a practical range. (Russell-East Central).

## 1357-C2, D1, D2, D3, E3
### NUTRITIVE EVALUATIONS OF ANIMAL MANURES
L. W. Smith,
Symposium: Processing Agricultural and Municipal Wastes, New York, New York, August 27-28, 1972, p. 55-74. 1 fig. 8 tab, 92 ref.

Descriptors: *Nutrients, *Farm wastes, *Recyling, *Feeds, Chemical properties, Nitrogen, Ruminants Fermentation, Cellulose.
Identifiers: *Waste utilization, Processing methods, Digestibility, Wastelage.

Three major factors influence chemical compositions of animal manures: (1) the species of animals; (2) the compositions of diets fed; and (3) the plane of nutrition. Feeding trials illustrate that poultry manure is high in nitrogen and is more advantageously utilized by ruminants than by other animals. Ruminants also have a lower digestibility of cell walls than do monogastric species. Thus, monogastric feces are clearly shown to be superior in nutritive value to ruminant feces, as indicated by the higher nitrogen and low cell wall content of higher digestibility. However, before manure can be utilized as a nutritive feed, economical processing methods must be developed. Several methods have been reported for using biological intermediates for recovery of protein from maure. Also rapid advances in physical, chemical, and fermentation technology will provide better methods for conversion of manures into products of high nutritive value for animal feeding. ( Russell-East Central).

## 1358-A1, A13, B2, D3, E3
### AUTOMATED RECYCLE SYSTEM FOR LIVESTOCK WASTE TREATMENT
E. P. Taiganides, and R. K. White,
Symposium: Processing Agricultural and Municipal Wastes, New York, New York, August 27-28, 1972, pp. 75-83. 10 fig.

Descriptors: *Recycling, *Farm wastes, *Waste treatment, *Livestock, *Automation, Oxidation lagoons Effluent, Foaming, Influent, Biochemical oxygen demand.
Identifiers: Water flushing, Sludge index.

In today's large confined swine facilities, the waste handling and treatment system is often the factor controlling the success of the operation. Certain criteria must be considered in order to evaluate the livestock waste system—namely, ecology, economics, esthetics, and technology. A five hundred pig swine unit was tested by treatment and recycling of the effluent. Automated flushing from the swine building worked extremely well. There was little odor in the confinement building and no odor in the waste facility. Foaming of the oxidation ditch was a problem but a foam-suppressing drum has been the most suitable method for controlling the foam. Over a ninety percent reduction in the biochemical oxygen demand of the influent to the oxidation ditch, as compared to the effluent for recycling, has been achieved. The use of a Sludge Index has been found to be a good parameter for monitoring the operation of the oxidation ditch. (Russell-East Central).

## 1359-B3, D2, E3
### FUEL FROM AGRICULTURAL WASTES
Herbert R. Appell, and Ronald D. Miller.
Symposium: Processing Agricultural and Municipal Wastes, New York, New York, August 27-28, 1972, p. 84-92. 5 tab, 5 ref.

Descriptors: *Farm wastes, *Fuels, *Oil, *Waste treatment, Organic matter, Biodegradation Waste water reclamation, Cellulose, Catalysts, Carbohydrates.
Identifiers: Ash content, Carbon monoxide, Raw materials.

Recognition of the increasing severity of the solid wastes problem has resulted in an increased research effort to find uses for waste materials. The conversion of a variety of wastes having a high carbohydrate content, largely cellulose, to a heavy oil has been one proposed method. A mechanism for the conversion of carbohydrates to oil consists of the following steps: (1) reaction of sodium carbonate and water with carbon monoxide to yield sodium formate; (2) dehydration of vicinal hydroxy groups in a carbohydrate to an enol, followed by isomerization to a ketone; (3) reduction of the newly formed carboxyl group to the correpsonding alcohol with formate ion and water; and (4) the hydroxyl ion then reacts with additional carbon monoxide to regenerate the formate ion. Although manures are in some respects a desirable feedstock for conversion to oil, the high ash content, and the malodorus aqueous effluent pose problems for further research. (Russell-East Central).

## 1360-D2, E3
### ENERGY FROM THE PYROLYSIS OF AGRICULTURAL WASTES
M. D. Schlesinger, W. S. Sanner, and D. E. Wolfson.
Symposium: Processing Agricultural and Municipal Wastes, New York, New York, August 27-28, 1972, p. 93-100, 1 fig. 3 tab 4 ref.

Descriptors: *Farm wastes, *Waste treatment, *Waste disposal, Volatility, Cattle, Energy.
Identifiers: *Pyrolysis, *Agricultural wastes, Wood waste, Crop wastes, High moisture feedstock.

Experiments were conducted on various agricultural wastes which involved pyrolysis, or the heating of a material to a high temperature in the absence of air. Materials that cannot be burned cleanly in incinerators can be converted to gases, oils, or solids that can be burned cleanly by known methods. Generally, wastes are not available on a year-round basis except in a limited number of circumstances. Crops are harvested at particular times of the year, and feedlots may vary in their population. Because of this irregularity, it seems important to convert wastes of different composition and quantity into a form that may approach compatability with industrial firing practices. Pyrolysis provides this conversion and is self-sufficient in energy requirements. Practically all the energy in the feeds is recovered in the products. (Russell-East Central).

## 1361-A8, B3, D3, E2
### COMPOSTING AGRICULTURAL AND INDUSTRIAL ORGANIC WASTES
S. J. Toth.
Symposium: Processing Agricultural and Municipal Wastes, New York, New York, August 27-28 1972, pp. 172-182. 4 tab, 8 ref.

Descriptors: *Farm wastes, *Industrial wastes, Moisture content, Aeration, Nitrogen, Phosphorous, Potassium, Livestock, Poultry, Sewage sludge, Municipal wastes, Chemical properties, Physical properties.
Identifiers: *Composting, *Agricultural wastes, *Organic wastes, Organic residues, Cellophane wastes,

Composts, like plant residues and organic wastes, tend to produce changes in the physical and chemical properties of soils in which they are incorporated. One of the changes in physical properties is an increase in soil aggregation. Addition of composts to soils also adds to the nitrogen, phosphorus, and potash contents of the soils. Many factors such as moisture content, aeration, nitrogen, phosphorus, and potassium, affect composting rates. When composting is finished, the ideal compost has a dark brown color, 80% organic matter, a moisture level of 10-20%, a water holding capacity of 150-200%, an ash content of 10-20%, a nitrogen content of 2.5-3.5%, a phosphorus oxide and potassium oxide content of 1-1.5%, a pH of 5.5-6.5%, and a slightly musty odor. Composts not only consist of animal wastes, but also industrial wastes which are high in carbon or organic matter. Municipal garbage has been studied as a composting material, but these products have little agricultural value when spread on land. (Russell-East Central).

## 1362-A5, A8, C1, C2, C3, E2
### POULTRY MANURE DISPOSAL BY PLOW-FURROW-COVER
The College of Agriculture and Environmental Science, Rutgers Univ.—the State University of New Jersey, New Brunswick, New Jersey 08903.

Descriptors: Agricultural machinery, *Deposition, *Organic wastes. Soils, fertilizers, *Wastes, *Waste disposal, *Pollution, Slurries, Poultry, Water pollution, Soil water, Contamination, Percolation, Equipment, Decomposition, Ground water, Salmonella, Test facilities, Recycling.
Identifiers: *Plow-Furrow-Cover technique, *Poultry manure, Solid waste disposal, Resource recovery, Fecal coliform. Suction lysimeters, Technicon Auto-Anlayzer.

This study consisted of 4 years of research conducted to determine the feasibility of the Plow-Furrow-Cover (PFC) method of manure disposal. The purposes of the research included development of equipment and techniques for the disposal of poultry manure in soil, and measurement of the consequent chemical, physical, and biological changes. Various sections of the report described the development of equipment; effect upon ground water; laboratory decomposition studies and salmonella; and effect on soil water and the soil. Poultry manure was used as the organic waste, and there was no indication of ground water pollution by fecal coliform. The upper limit of poultry manure disposal appeared to be less than 15 tons per acre of dry material because of nutrient contamination in the soil water. The PFC technique utilized the soil media for degradation and the eventual utilization and recycling of organic wastes by plants.

## 1363-C1, D3
### EFFECTS OF PARTICLE SIZE ON THE AEROBIC TREATMENT OF ANIMAL WASTE
James A. Lindley.
MS Thesis, Department of Agricultural Engineering, Purdue University, 1970, 122 p. 31 fig, 41 tab, 38 ref.

Descriptors: *Farm wastes, *Aerobic treatment, *Particle size, Chemical oxygen demand, Biochemical oxygen demand, Aeration, Sampling, Analysis, Feeds, Dairy industry, Cattle, Waste treatment, Volatility, Digestion, Nebraska.
Identifiers: Refeeding.

Design of efficient treatment processes (such as aerobic biological treatment) requires a thorough knowledge of the waste and effects of variation in this material. Research was conducted to study the effects caused from differences of fractions with particle sizes that could be measured by sieving techniques. The results of analyzing 24 samples of dairy farm wastes gave an average geometric mean particle size of 860.85 microns. The mean range was from 1490 microns to 402 microns. Organic content was found to increase with particle size of 860.85 microns. The mean range was from 1490 microns to 402 microns. Organic content was found to increase with particle size, while chemical oxygen demand and biochemical oxygen demand varies inversely with particle size. The rate of volatile solids decomposition in an aerobic treatment process may decrease with larger waste fineness values, but the effect is slight. (Frantz-East Central).

## 1364-B2, C1, C2, D1

### SETTLING SOLIDS IN ANIMAL WASTE SLURRIES

J. A. Moore, R. O. Hegg, D. C. Sholz, and Egon Strauman.
Presented at the 66th Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, 17 p. 5 fig, 1 tab, 14 ref.

Descriptors: *Farm wastes, *Slurries, *Sedimentation, Sampling, Chemical oxygen demand, Livestock, Waste treatment, Suspended solids, Design data, Feed lots, Solid wastes, Minnesota.
Identifiers: *Settling solids, Total solids, Volatile solids.

Research was conducted to develop design curves which may be used in applying sedimentation principles to the treatment of animal wastes. Samples of slurries were measured for solids at the tops of cylinders at O, 1, 10, 100 and 1000 minutes. The chemical oxygen demand, total solids (TS), and total volatile solids (TVS) were determined for waste samples from poultry, beef and dairy cattle, horses, and swine. It was concluded that settling can efficiently remove TS and COD. The shapes of the design curves were almost identical regardless of the percent TS slurry within the range of 1 to .01%. TS values were generally higher than COD values. For closed recycling systems, one to ten minutes of detention time might be used for design purposes. (Frantz-East Central).

## 1365-B2, C1, C2, E2

### QUALITY DEGRADATION OF DAIRY WASHWATER

A. C. Chang, G. Yamashita, J. B. Johnson, K. Aref, and D. C. Baier.
Presented at the 1973 Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-440, 21 p.

Descriptors: *Quality control, *Degradation (Decomposition), *Dairy industry, *Groundwater pollution, *Farm wastes, Cattle, Waste disposal, Effluent, Chemical properties, Physical properties, Nitrogen, Salts, Chemical oxygen demand, Waste water (Pollution) Return flow, California.
Identifiers: *Wastewater.

Representative samples from twenty-five dairies, divided into five groups according to size, were evaluated for quality degradation of dairy washwater. The water supply was totally dependent upon the underground source. The physical and chemical properties of wastewater were compared with those of the water used before washing. The greatest increase was in chemical oxygen demand, total nitrogen and total dissolved salts. The increment was at least 4-5 times higher than that in water used for domestic purposes. Removal of nitrogen and dissolved salts is the major concern for making water more suitable for land disposal. (Frantz-East Central).

## 1366-A3, A4, A5, B2, B3, B4, C2, C3, E2, F1

### WATER POLLUTION BY DAIRY FARM WASTES AS RELATED TO METHOD OF WASTE DISPOSAL

Auburn University, Auburn, Alabama, Water Resources Research Institute.
T. A. McCaskey, G. H. Rollins, and J. Little.
Water Resources Research Institute Bulletin 18, 1973, 86 p. 12 fig, 24 tab, 3 append.

Descriptors: *Livestock wastes, *Manure, *Dairy farms, *Waste disposal, Soil disposal fields, Irrigation waste disposal, Manure lagoons, Runoff, Water quality.
Identifiers: *Waste disposal methods, *Field spreading, *Manure loading rates, Runoff quality, Lagoon efficiency.

Three field spreading methods and a lagoon system were evaluated for the disposal of dairy-cow waste. Three rates of waste were applied to grassland plots by each of the field spreading methods for 27 months. Runoff water was collected from the plots, and also from a check plot to evaluate runoff water quality. The scrape-haul method contributed more BOD load to runoff, and more fecal coliforms and nitrate to the soil than the irrigation or tank-wagon methods. The most BOD and nitrate in runoff during 1971 for all methods of field spreading waste occurred during August during which the rainfall was lowest for the year. The least BOD and nitrate in runoff coincided with the month of most rainfall (March). At 10 to 21 tons waste applied annually on grassland there was not an appreciable deterioration of runoff water quality nor buildup of soil nitrate. A two-stage lagoon system designed for 30 cu. ft. storage capacity per cow in the first stage and 643 cu. ft. capacity in the second stage for cows using milking facilities reduced BOD, 95%, COD, 93% Kjeldahl-nitrogen, 82% and fecal coliforms, 99%. For herds of 120 cows in confinement the estimated annual cost per cow for manure management by the irrigation method was $30.31 and $24.07 for the scrape-haul method. The cost for systems that accomodated cows during milking was estimated at $11.24 per cow for the lagoon method and $21.21 per cow for the tank-wagon method. (McCaskey-Auburn).

## 1367-A2, A5, A8, B1, C2, C3

### MICROBIAL CHANGES AND POSSIBLE GROUND WATER POLLUTION FROM POULTRY MANURE AND BEEF CATTLE FEEDLOTS IN GEORGIA

Department of Agronomy, University of Georgia, Athens.
J. Giddens, A. M. Rao, and H. W. Fordham.
Completion Report. USDI/OWRR Project No. A-031-Ga. Department of Agronomy, University of Georgia, May, 1973, 57 p. 14 fig, 16 tab, 6 ref.

Descriptors: *Groundwater pollution, *Farm wastes, *Poultry, *Feed lots, *Cattle, *Georgia, Nitrates, Nutrients, Coliforms, Agricultural runoff, Ammonia, Volatility.
Identifiers: *Microbial changes, *Manure.

Laboratory and field studies were made to determine the effect of methods of application and handling poultry manure upon nitrate and other nutrients in the soil and microbial changes during decomposition. One-half the nitrogen in poultry manure volatilizes upon air-drying. Repeated light manure applications produced less soil nitrate than the same total amount applied less frequently, and soil surface applications produced less nitrate than when soil incorporated. Coliform bacteria decreased rapidly when manure was mixed with soil or when exposed to ammonia. Soil fungi decreased during early manure decomposition stages. Coliforms were at a high level in pond water when periods of rainfall runoff occurred. A survey of soil at 21 beef cattle feedlots indicated that groundwater contamination from the feedlots would probably not be significant but that contamination from surface runoff would possibly present a greater pollution hazard. (Giddens, et. al.,—Georgia University).

## 1368-B2, B3, B4, E1, F4

### ENVIRONMENT PROTECTING CONCEPTS OF BEEF CATTLE FEEDLOT WASTES MANAGEMENT

Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma.
L. R. Shuyler, D. M. Farmer, R. D. Kreis, and M. E. Hula.
National Animal Feedlot Wastes Research Program, Robert S. Kerr Environmental Research Laboratory, July, 1973, 283 p. 71 fig, 62 tab, 197 ref.

Descriptors: *Feed lots, *Farm wastes, *Design, Regulations, Legal aspects, Climates, Sites, Agricultural runoff, Slurries, Solid wastes, Liquid wastes, Waste storage, Waste treatment, Waste disposal.
Identifiers: Environmental protection, *Pollution control.

This report is meant to serve as a guide to insure consideration and incorporation of pertinent environmental pollution controls in the design and operation of beef cattle feedlots. The report is written to serve as a reference source for the more detailed information contained in published literature on feedlot design and operation. Feedlot design and waste management alternatives are presented. Aspects of feedlot site selection such as regulations, spatial requirements, topographic features, microclimates, soils and geological features, social considerations, and practical applications are discussed. Solid waste control and liquid waste technology is presented and the economic consideration of each system is dealt with. The information and guidelines presented aren't restricted to cattle feedlots. They are also applicable to other segments of the animal industry. (Russell-East Central).

## 1369-A6

### GAS CHROMATOGRAPHIC ANALYSIS OF ODORS FROM DAIRY ANIMAL WASTES

Ohio State University, Columbus.
R. White.
Ph. D. Thesis, Department of Agricultural Engineering, Ohio State University, 1969, 143 p. 36 fig, 23 tab, 61 ref.

Descriptors: *Gas chromatography, *Analysis, *Odor, *Dairy industry, *Farm wastes, Cattle, Waste treatment, Sampling, Measurement, Liquid wastes, Waste storage, Temperature, Hydrogen ion concentration, Aeration, Volatility.
Identifiers: *Malodors, *Odor index peaks.

Recent developments in confinement animal production has brought into focus the problem of odor nuisance from dairy animal units. Gas chromatographic analysis was used to analyze the odors from simulated liquid storage of dairy manures. The equilibrium collector, transfer apparatus, and injection apparatus as developed in this study, functioned to give reliable, repetitive analyses of the head space gas over dairy manures. Eleven odor index peaks were characteristic of untreated dairy wastes. Six of these were identified as hydrogen sulfide, methanethiol, dimethyl sulfide, propyl acetate, and n-butyl acetate. The effect of aeration was to reduce or eliminate the thiol, sulfides, and acetates. The effect of pH and electrode potential had about the same effect as aeration. When calcium hydroxide was added at the beginning of a test a slight reduction in odor was indicated. The apparatus developed has now made it possible to extend study into more comprehensive investigations of odor and management in animal production units. (Russell-East Central).

## 1370-A5, A8, C2, E2

### TRANSACTIONAL DYNAMICS OF POULTRY MANURE IN SOIL

L. H. Hileman.
Paper presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-956, 15 p. 6 fig, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Soils, *Leaching ion exchange, Ground water pollution, Calcium, Potassium, Ammonia, Manganese.
Identifiers: *Manure, *Transactional dynamics.

Poultry broiler manure was surface applied to Taloka silt loam soil columns at rate of 0, 2, 4, 6, 8, 10, 20, and 40 tons per acre. The soil columns were leached with distilled water at the rate of approximately one acre inch per week for 16 weeks. The gravitationally leached water was collected for chemical analysis. Data presented indicated the intensity of dynamic transaction and cation exchange taking place in the soil due to the large application of litter. Potassium in the manure exchanged for soil calcium. Calcium in the leachate reached 800 ppm. High levels of manganese were found in the leachate. Consideration must be given to the soil and to the soil water when applying high rates of poultry manure. (Cartmell-East Central).

## 1371-A1, B1, F2

### FEEDERS IGNORE POLLUTION RULES: RISK STIFF FINES

BEEF, Vol. 10, No. 7, p. 70-71, March, 1974. 3 fig.

Descriptors: *Feed lots, *Regulation, *Fines, *Permits, Cattle, Weather, Equipment, Effluent, Waste disposal.
Identitfiers: *Rules, *Pollution, *Environmental Protection Agency, *Waste management, Discharges.

Feedlot operators can be fined as high as $25,000-a-day if they haven't filed for an Environmental Protection Agency waste discharge permit. A large number of feeders across the United States are running the risk of being hit with these fines. Any feedlot operator who has one thousand head or more in his feedlot must have a permit in order to discharge waste legally. Also, anyone who is notified that he is a "significant contributor of pollution" must apply for a permit. After permits are drafted, they are put on public notice for thirty days. If there are public comments, then a hearing must be held to clear up misunderstandings. When a person files for a permit, his operation is investigated and construction of waste handling systems is ordered if needed. The EPA guidelines establish an effluent limitation of "no discharge" by 1977, but exceptions will be made for extreme weather. It is hoped that by such action, pollution from animal wastes will be controlled. (Russell-East Central).

## 1372-D2, E3, F1

### FEEDLOT MANURE AND OTHER AGRICULTURAL WASTES AS FUTURE MATERIAL AND ENERGY RESOURCES: III. ECONOMIC EVALUATIONS

Department of Chemical Engineering, Kansas State University, Manhattan, 66506.
W. P. Walawender, L. T. Fan, C. R. Engler, and L. E. Erickson.
Contribution Number 33, Department of Chemical Engineering, Kansas Agricultural Experiment Station, Manhattan, July 1, 1973, 23 p. 9 tab, 45 ref.

Descriptors: *Feed lots, *Farm wastes, *Recycling, *Energy, *Waste treatment, *Waste disposal, Economics, Costs, Transportation, Carbon dioxide, Water.
Identifiers: *Manure, *Agricultural wastes, *Liquifaction, *Gasification, *Hydrogasification, *Oil conversion, Cellulosic wastes, Processing.

Due to increasing waste problems and energy demands, a study of the feasibility of chemical processing of agricultural wastes was undertaken. The study dealt primarily with feedlot manure because of its availability and its present hazards to environmental quality. This report presents the results of an economic analysis of three potential processing schemes for the conversion of feedlot wastes to useful products. The processes include (1) liquefaction to oil, (2) gasification to synthetic gas, and (3) hydrogasification to methane. Processing costs, on a per ton of wet manure feed basis, were found to be $4.27, $1.53, and $9.41, respectively. (These costs include credit only for the sale of the major product at approximately current prices.) Capital investment and the break-even sales price for the major product are presented. The results strongly favor the synthesis gas process; however, markets for the product require further consideration. (Russell-East Central).

## 1373-A11, B1, F1

### HOUSING AND SHELTER FOR FEEDLOT CATTLE

University of Minnesota.
J. C. Meiske, R. E. Smith, R. D. Goodrich, and H. E. Hanke.
FEEDLOT MANAGEMENT, 1973 CATTLE FEEDER'S PLANNER, November, 1973, p. 44-52, 84. 5 fig, 3 tab.

Descriptors: *Feed lots, *Cattle, *Confinement pens, Costs, Economics, Performance, Farm wastes, Feeding, Weather, Design.
Identifiers: *Housing, *Shelter, Open shed, Open lot, Manure pack system, Insulated confinement barn.

In the selection of a feedlot facility, consideration must be given to factors such as weather, pollution control regulations, the need to save labor, and the desire to eliminate bedding and to provide an environment which would enable cattle to have improved feed efficiencies and faster gains. Five types of feedlot facilities were studied. These were: (1) the open confinement shed; (2) the manure pack system; (3) the conventional open shed; (4) the enclosed insulated confinement barn; and (5) the open lot unit. Of these systems each has advantages and disadvantages, and the best system would be the one that best fits a particular need and operation. The lowest cost per head system is the open lot unit, and the most expensive is the insulated confinement building. However, gain is greater in the confinement building than in the open lot. In other words, no particular system is superior to all others. Each system's success is dependent on a particular set of circumstances and, with all systems, good construction and alert management are necessary for consistent returns. (Russell-East Central).

## 1374-B2, B3, D1, D2, E2, E3

### A FEEDLOT WITHOUT WASTE

Editor of BEEF.
P. D. Andre.
BEEF, Vol. 10, No. 1, p. 56-66, 69-70, Sept., 1973. 5 fig.

Descriptors: *Feed lots, *Farm wastes, *Cattle, *Confinement pens, *Recycling, *Waste treatment, *Waste disposal, Urine, Methane, Liquid wastes, Solid wastes, Separation techniques, Feeds, Nitrogen, Dehydration, Costs, Arizona.
Identifiers: Refeeding, Sterilization.

A system or theory for the solution to the feedlot industry's manure problems has been devised by Dick Bunger who is the president of Corral Industries Inc. He has called this the "Closed Ecological Cycle Feeding System." As he sees it, feeding in the future must be in confinement buildings. This is because of the increasing scarcity of land, pollution regulations, and weather. His studies show that confinement feeding produces the same gains as open feedlot, but it produces better gains during bad weather. This system first collects the waste and separates urine and feces. The liquids then go to a methane gas generator. The by-products of the liquids are then safe to be spread on land. By running the liquids through the gas generator, the nitrogen and other chemicals are reduced so that for a 10,000 head feedlot, instead of needing 4,204 acres for spreading the raw materials, only 200-500 acres would be required in one year's time. The solid matter is sterilized and then is incorporated into the feeding ration. (Russell-East Central).

## 1375-B2, C1, C2, D3

### THE EFFECT OF LOW VOLUME AND HIGH VOLUME AERATION ON A HOG LAGOON

J. C. Converse.
MS Thesis, Department of Agricultural Engineering, North Dakota State University, May, 1966, 85 p. 44 fig. 5 tab, 19 ref.

Descriptors: *Hogs, *Farm wastes, *Waste treatment, *Lagoons, *Aeration, Temperature, Hydrogen ion concentration, Biochemical oxygen demand, Chemical oxygen demand, Suspended solids, Ammonia, Nitrates, Nitrites, Sampling, Oxidation-reduction potential, Dissolved oxygen.
Identifiers: Total solids, Volatile acids.

The objectives of the study were to evaluate the effects of low and high volume subsurface aeration on a hog lagoon. Laboratory tests were run on low and high volume samples and control samples. Among factors tested were: Temperature, pH, BOD, COD, total and suspended solids, ammonia, nitrate, nitrite, ORP, volatile acids (high volume aeration) and DO (high volume aeration). The low volume subsurface aeration which ranged from 3.6 cfm had no measurable effect on the hog lagoon. For all of the tests conducted there appeared to be no significant difference between the means of the values obtained in the test for the aerated and the control cells. During the high volume aeration phase, an average of 2.28 mg/l of dissolved $O_2$ was maintained in the aerated cell during the testing period. All of the tests showed a significant difference of the means, except the total solids, the suspended solids, the organic matter, and the ammonia. Based on the analysis of this experiment, it may be beneficial to aerate a hog lagoon with at least enough air to maintain some dissolved oxygen in the lagoon. The aeration would allow the lagoon to be loaded at a higher rate and still maintain aerobic conditions. Economical considerations may make this unfeasible. (Cartmell-East Central).

## 1376-A2, C1, C2

### POLLUTION POTENTIAL OF RUNOFF FROM PRODUCTION LIVESTOCK FEEDING OPERATIONS IN SOUTH DAKOTA

Civil Engineering, Water Resources Institute, South Dakota State University.
J. N. Dornbush, and J. M. Madden.
Completion Report, April, 1973, 37 p. 3 fig, 12 tab, 3 ref.

Descriptors: *Agricultural runoff, *Feed lots, *Livestock, *South Dakota, *Farm wastes, Nutrients, Rainfall-runoff relationships, Snowmelt, Biochemical oxygen demand, Chemical oxygen demand, Solids, Pollutants.
Identifiers: *Pollution.

The quantity and quality of runoff from six feedlots in eastern South Dakota has been measured over a 3-year period. Annual precipitation at the feedlots ranged from 19 to 25 inches which was about normal for the area. Snowmelt accounted for 27% of the mean runoff of 7.2 inches for the six lots. After snowmelt runoff, rainfall caused only about 10 runoff events per year and about 50% of the runoff events were less than 0.25 inches. Average annual losses of waste constituents in the runoff in lbs/acre/yr were total solids—10,332, BOD-1816, COD—7496, total phosphate—351, and Kjeldahl nitrogen—533; although, there was wide variation between lots. Removal of solids from the runoff would reduce the pollution potential by about 35% for most constituents. Less than 5% of the total waste generated on a lot was removed with surface runoff. Minimum detention facilities, diverting foreign drainage and reduction of runoff velocities, will reduce the pollution potential to less than 2% of the total animal wastes produced. (Dornbush and Madden-South Dakota State University).

## 1377-A11, B1

### WHAT TO DO ABOUT POULTRY'S PROTEIN-ENERGY CRISIS

Poultry Science Department, University of Georgia, Athens.
L. S. Jensen.
Poultry Digest, Vol. 32, No. 381, p. 489-492, November, 1973, 1 fig.

Descriptors: *Poultry, *Proteins, *Energy, Ammino Acids, Feeds, Diets, Recycling, Management.
Identifiers: Antibotics, Fats, Calories.

It may be necessary to develop new sources of nutrients, use existing sources more efficiently and make some changes in management to offset the increasing costs of feeds. Jensen cites the following as means of improving nutritional formulation of poultry rations: (1) Reduce protein levels, (2) Use synthetic amino acids, (3) Improve feed quality control, (4) Consider "extra" caloric effect of fat, (5) Use effective antibotics for growth stimulation, (6) Consider protein or amino acid sparing factors. Limiting feeding, controlling feed wastage, and identifying factors causing variations in the performance among contract growers should also bring about a better overall utilization of expensive broiler feed. (Ballard-East Central).

### 1378-A1, D2, D3, E2, E3
### THE BUILDING OF A FEEDLOT

Mower Lumber Company, Eutawville, South Carolina.
P. W. Schumacher.
Presented at the 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, Paper No. 73-4542, 7 p.

Descriptors: *Feed lots, *Farm wastes, *Cattle, *Waste disposal, *Dairy industry, Fermentation, Feeds, Humidity, Recycling, South Carolina.
Identifiers: *Manure-flush system, Refeeding, Silos, Feed efficiency, Shade, Land spreading.

With the establishment and maintenance of a feedlot operation on Walworth Farms, Eutawville, South Carolina, it was shown that cattle feeding can be done successfully in the Southeastern United States. A liquid pipeline system was constructed in which wastes were flushed from sloping concrete pens, carried off by pipeline, and spread over the surrounding sandy cropland. A fermentation feeding method was developed which resulted in 10 to 12 percent improved feed efficiency and 8 to 12 percent weight gain increase. Also discussed are the environmental effects of manure spreading and of refeeding solid wastes separated by the liquid handling method. (Hargrove-East Central).

### 1379-B3, B4, D3, E2
### SOLID WASTE MANAGEMENT ALTERNATIVES

B. Sullivan.
Feedlot Management, Vol. 15, No. 5, p. 26-30, May, 1973.

Descriptors: *Solid wastes, *Farm wastes, *Feed lots, *Waste storage, *Waste disposal, *Economics, Costs, Transportation, Fertilizers, Equipment, Nitrogen, Cattle.
Identifiers: *Waste management, Commercial loader, Spreader truck, Rotary scraper, Windrow composting.

Solid manure management involves collection, transportation, storage, processing and disposal—operations that encompass an array of techniques and equipment which can be used in many combinations. The costs of these operations and removal vary with feedlot size, annual days of equipment use, and manure hauling distance. An economic comparison is made of the use of a commercial loader (skip loader) and a spreader truck, a rotary scraper attached to a tractor, and a self-propelled elevating scraper. The pros and cons of waste storage by composting in windrows and of waste disposal on crop lands are also considered. (Cameron-East Central).

### 1380-A11, B1, F1
### RESEARCH CONCEPTS

W. O'Rourke.
Calf News, Vol. 10, No. 4, p. 16, 48, April, 1972. 1 tab.

Descriptors: *Research, *Cattle, *Feeds, *Water consumption, *Growth rates, Confinement pens, Energy, Economics, Farm wastes, Tennessee.
Identifiers: *Water restriction, Roughage, Weight.

Raising calves in a feedlot requires energy restriction. This may be done by (1) Feeding roughages such as hay, straw, and corn, and (2) Feeding a limited amount of an energy-dense feed formulated to supply daily requirements of essential nutrients. Both methods have drawbacks, however, which leads to the question approached in the experiment—can feed intake be closely controlled through water restriction? Three small pens (30' by 90') were adapted to study the effect of water restriction on feed consumption. Fifteen 450 pound steer calves were placed in each pen. One pen of calves was fed chopped alfalfa hay, plus a 1:1 mixture of salt and decalcium phosphate. The calves in the remaining two pens were changed to a high-energy finisher ration. One pen of the calves received only a measured amount of water each day. The results showed that cattle health, gain, and feed efficiency after fill were encouraging. Water restriction is a useful way to reduce feed consumption and restrict gain. Feed efficiency in comparison to the hay-fed cattle is marked and with milo presently costing less than medium quantity alfalfa hay, the economy of restricting intake of a high energy ration by water restriction is excellent. (Drewry-East Central).

### 1381-B1
### BAFFLED CENTER CEILING VENTILATION INLET

Agricultural Engineering Department, South Dakota State University, Brookings.
M. A. Hellickson.
Transactions of the ASAE, Vol. 16, No. 4, p. 758-760, July-August, 1973, 6 fig. 13 ref.

Descriptors: *Ventilation, *Temperature, *Intakes, *Baffles, *Cattle, *Air circulation.
Identifiers: *Ceiling ventilation, *Inlet, Exhaust fans, Manure pit.

In the summers of 1970 and 1971, studies were made on the ventilation characteristics in the Farmers' Union Grain Terminal Association's 48 by 40 ft. closed confinement beef unit. The original ventilation system employed two thermostatically controlled variable speed exhaust fans and four constant speed exhaust fans. This design allowed summer ventilation air to enter the building through baffled 4 inch continuous inlets along the north and south walls. The inlet system was redesigned prior to use during the summer of 1971. The new design employed a center ceiling inlet for year-round ventilation. Air movement in the closed environment beef unit during 1970 almost exclusively occurred in the upper portion of the building. In 1971, air circulation around the animals was clearly noticeable and ventilation was much better. Average temperature at animal level from June 26 to October 30, 1971, exceeded average outside temperature by 4.4° F. In 1970, the average temperature at animal level exceeded average outside temperature by 9.6° F. In 1971 tempering of ventilation air in the north half of the attic ranged from 5° F above to 20° F below and averaged 0.2° F above outside temperature from June 26 to October 30. Although solar tempering was greatest during hot weather, ambient temperature exceeded outside temperature more during periods of cooler temperature. (Cameron-East Central).

### 1382-A2, A6, D1
### SOLIDS TRAP FOR BEEF CATTLE FEEDLOT RUNOFF

United States Department of Agriculture, Lincoln, Nebraska.
N. P. Swanson and L. N. Mielki.
Transactions of the ASAE, Vol. 16, No. 4, p. 743-745, July/August, 1973. 2 fig, 2 tab.

Descriptors: *Cattle, *Feed lots, *Agricultural runoff, *Solid wastes, *Waste storage, *Waste treatment, Sediment transport, Physical properties.
Identifiers: *Solids trap.

Solids transported by runoff from cattle feedlots and allowed to deposit in a holding pond in uncontrolled quantities create three serious problems. First, runoff storage capacity is reduced by deposited solids. Second, emptying by pumping is difficult when solids have accumulated. Third, decomposition of the solids produces odors in warm weather. In 1969, a solids trap consisting of a broad, flat channel 14 feet wide and 80 feet long was installed to pass the runoff collected from a sloping 0.85-acre feedlot. The channel was about 2½ feet deep and sloped only 3 or 4 inches toward the discharge end. Mesh galvanized hardwarecloth screens were installed vertically across the channel and placed 35 and 55 feet from the inlet end of the channel. On July 23, 1971, 21 cubic yards of solids were removed from the holding pond. This was the total accumulation of settleable solids from July 3, 1969. In this two-year interval, the trap retained 81 cubic yards of sediments from 12.33 inches of runoff produced by 50.77 inches of precipitation. No problems arose in removing the solids from the trap. Installation of a concrete or crushed rock surface in the channel bottom may be desirable where removal of solids with higher water contents is required. (Drewry-East Central).

### 1383-A11, B3, B5, C2, D3
### BROILER LITTER MANAGEMENT

Department of Poultry Science, Oregon State University.
R. W. Dorminey, and P. H. Weswig.
Unpublished paper, 3 p.

Descriptors: *Poultry, *Litter, *Management, Broods, Weather, Chemical analysis, Nitrogen, Oregon.
Identifiers: *Broilers, *Composting, Fir shavings, Commercial additive, Cedar mulch.

Six instructions for composting litter were given and discussed. A series of experiments was conducted with four treatments being used: (1) pens cleaned out and new fir shavings added after each brood; (2) one to two inches plus wet spots removed and replaced with new fir shavings; (3) fir shavings used once, then composted after each brood using the commercial additive; and (4) fir shavings used once, then composted after each brood without the commercial additive. A total of eight different broods were grown on composted litter. It was found that if the litter is dry and the weather conditions are moderately warm and dry when the litter is composted, the litter will dry sufficiently and broiler performance will equal or exceed that obtained with etiher new litter or with litter reused without composting. Litter can be composted without a commercial additive with exactly the same effects. Chemical analysis showed higher percentages after the composting for all elements except nitrogen. A material called cedar mulch can be satisfactorily used as a broiler litter and can be composted. (Cartmell-East Central).

### 1384-A6, A11, B2, D1, E2
### CONCRETE AND ALUMINUM FLOORS FOR CONFINEMENT BEEF FINISHING

Professor and Associate Head, Agricultural Engineering Department, University of Tennessee, Knoxville.
J. I. Sewell, and G. D. Miller.
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, 11 p. 2 tab, 7 ref.

Descriptors: *Concrete, *Confinement pens, *Cattle, *Farm wastes, *Waste storage, *Waste treatment, *Waste disposal, Performance, Costs, Odor, Tennessee.
Identifiers: *Slatted floors, *Aluminum, *Beef finishing, Gains.

A slatted-floor beef finishing facility was completed in the fall of 1971 at the University of Tennessee Aluminum Company of America Farm. An existing barn with a concrete-slab floor was remodeled to include aluminum slats and reinforced-concrete slats installed over reinforced manure collection pits in half the barn (six pens), while the slab was left intact in the other half (four pens). The liquid manure in the pits was agitated, removed from the pits by liquid manure tank-spreaders, and spread on crop or pasture land. Data were collected on facility design, costs, manure accumulation rates, manure removal procedures, stocking, density, for manure management on slatted-floor and concrete-slab floor systems. Bulls fed on floors of aluminum slats, concrete slats, and concrete slabs exhibited similar gain performance. After two years, the aluminum slats have been only slightly damaged by electrolysis or the weight of the cattle. Aluminum slats were noticeably cleaner than concrete slats. (Cartmell-East Central).

## 1385-B3, C1, C2, D2, E3

### CHEMICAL COMPONENTS AND ESTIMATED DIGESTIBILITY OF DEHYDRATED CATTLE MANURE

Bureau of Reclamation, Grand Junction, Colo.
C. W, Berg, G. L. Pratt, M. L. Buchanan, and D. O. Erickson.
Presented at the 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, 13 p. 7 fig, 4 tab, 4 ref.

Descriptors: *Farm wastes, *Cattle, *Dehydration, *Chemical properties, Temperature, Moisture content, Sampling, Silica, Lignins.
Identifiers: *Manure, *Digestibility, Mineral content, Fiber.

Beef cattle manure samples were dried at 100°, 150°, or 200°F. At each temperature, samples were dried to final moisture contents of 14, 8, and 1 percent. Storage time was evaluated by varying the number of days that elapsed between cleaning operations in the barn. These intervals were 1, 2, 3, and 4 days. The manure still contained about 20 to 25 percent estimated digestible dry matter. The mineral content of the manure was higher than the ration. Increasing the drying temperature from 100° to 200°F, resulted in an increase in fiber, lignin and silica and a reduction in digestibility. There were little differences in chemical composition or digestibility of manure dried at 14 percent versus 8 percent, but 1 percent increased silica, fiber and lignin. Protein content decreased in the manure dried to 8 percent compared with that of 14 percent. Protein was reduced with time in storage in the pit. (Cartmell-East Central).

## 1386-B1, B5, D3, E3

### NEW CONCEPTS FOR DAIRY WASTE MANAGEMENT

School of Public Health, University of California, Los Angeles,
C. L. Senn.
Journal of Milk and Food Technology, Vol. 35, No. 12, p. 703-707, December, 1972.

Descriptors: *Dairy industry, *Farm wastes, *Waste treatment, *Waste disposal, *Waste storage, *Recycling, Water pollution, Air pollution, Feed lots, Waste water treatment.
Identifiers: *Waste management, *Composting, Aeration, Earth corrals, All-paved corrals, Environmental housing.

Public concern, coupled with that of health, agricultural, and milk industry people, prompted a dairy waste management project funded by the Environmental Protection Agency. The study included not only earth corrals, but also covered all-paved corrals—both water-flushed and mechanically cleaned. A simple aeration process produced compost at low cost. The product was "pasteurized," weed-seed free, and an attractive soil amendment. Aerobic composting with "environmental housing" and with aerobic treatment of liquid dairy farm wastes, gives promise of providing relatively nuisance-free and pollution-free, high density housing for approximately 200 cows per acre. (Drewry-East Central).

## 1387-B2, D3

### HOW TO PLAN AND MANAGE A LAGOON

Associate Swine Editor of Successful Farming.
B. Eftink.
Successful Farming, Vol. 71, No. 8, p. H4, June-July, 1973. 1 fig.

Descriptors: *Lagoons, *Planning, *Management, *Waste disposal, *Farm wastes, Hogs, Sludge, Aerated lagoons, Anaerobic conditions, Livestock.
Identifiers: Bedding.

To plan and manage a lagoon properly and effectively, there are several steps to follow. The lagoon must be built downwind from houses, away from water wells, yet close to the animals. The lagoon should also be large enough to contain the sludge from the animals. The lagoon should also be large enough to contain the sludge from the animals. Once the lagoon starts working, it's better to make frequent, small loadings instead of uneven, large loadings which cause bacteria fluctuations and poor decomposition. (Ballard-East Central).

## 1388-B1, B5, D3, E3

### BIODEGRADING POULTRY EXCRETA WITH HOUSE FLY LARVAE: THE CONCEPT AND EQUIPMENT

Entomology Research Division, Agricultural Research Service, United States Department of Agriculitre.
N. O. Morgan, C. C. Calvert, and R. D. Martin.
ARS 33-136, United States Department of Agriculture, Agricultural Research Service, February, 1970, 3 p. 1 fig. 2 ref.

Descriptors: *Poultry, *Farm wastes, *Biodegradation, Fertilizers, Organic wastes, Waste treatment, Waste disposal, Recycling, Equipment.
Identifiers: *Excreta, *House fly larvae, White leghorns.

The excretion of one White Leghorn laying hen amounts to 0.25-0.40 pound per day. This daily production creates an enormous disposal problem. In biodegradation experiments in Beltsville, Maryland, larvae of the house fly are being used to process the raw excreta of hens to produce a fertilizer or soil conditioner and a feed supplement. These experiments involve the hatching of the fly eggs on poultry feces. The eggs hatch and the larvae develop. The larvae then aerate the medium by their tunneling. (Ballard-East Central).

## 1389-A6, A7, B3, B5, C2, D2, E2,E3

### POULTRY ANAPHAGE IS HERE TO STAY

College of Agriculture and Natural Resources, Michigan State University, East Lansing.
H. C. Zindel.
Egg Industry, Vol. 6, No. 7, p. 22, 2 fig, 5 ref.

Descriptors: *Poultry, *Farm wastes, *Feeds, *Recycling, Productivity, Fertility, Calcium, Phosphorous, Waste treatment, Waste disposal,
Identifiers: *Dried poultry wastes, Hatchability, Necropsy.

On the basis of research, feed costs, and feed ingredient availability, dried poultry wastes were found practical and suitable for poultry and livestock feed. At Michigan State University, a 12.5 to 25 percent dried poultry waste diet replacement in poultry feeding over a 14 month period caused no change in production, fertility, or hatchability, and no discernible difference was revealed by necropsy. Potential poultry waste sales outlets are livestock and poultry feeds, mushroom culture media, and organic fertilizers. Since phosphorous and calcium were found to increase in recycling, feeding of dried poultry waste as a diet replacement should not exceed 25 percent. Keys to successful poultry waste dehydration are: (1) operation economy and ease, (2) packaging unity, (3) low service and maintenance costs, (4) emission control, (5) consistent and uniform production, (6) efficient continuous operation, and (7) compliance with EPA odor, smoke, and particulate standards. (Hargrove-East Central).

## 1390-A11, B1, B5, C2

### FECAL ELIMINATION OF ESTROGENS BY CATTLE TREATED WITH DIETHYLSTILBESTROL AND HEXESTROL

Department of Animal Science, Purdue University, Lafayette, Indiana.
M. R. Callantine, M. Stob, and F. N. Andrews.
American Journal of Veterinary Research, Vol. 22, p. 462-465, May, 1961. 2 tab, 13 ref.

Descriptors: *Farm wastes, *Cattle, *Sampling, Water pollution, Soil contamination, Fertilizers,
Identifiers: *Estrogens, *Diethylstilbestrol, *Hexestrol, Hormones.

The estrogenic activity of the feces of estrogen-treated and control heifers in 6 groups was determined during a 24-week period following initiation of hormone treatment. Animals given 10 mg. of diethylistilbestrol orally per day excreted significantly more estrogen than did the controls or heifers subscutaneously treated with 24 or 36 mg. of either diethylstilbestrol or hexastrol. This excretion was uniformly high for the entire experimental period. Subcutaneous implantation with 36 mg. of diethylstilbestrol resulted in a greater total estrogen excretion than treatment with 24 mg. However, significant amounts of estrogen were excreted for 60 days following treatment with 24 mg. of diethylstilbestrol when compared to that excreted for 51 days following 36 mg. implantations; after this time, fecal estrogen elimination of heifers in both groups was similar to the controls. Implantation of heifers with 24 or 36 mg. of hexestrol did not result in greater fecal estrogen elimination than in the animals not given supplementary estrogen; neither treatment produced significant weekly variation in estrogen excretion. (Callantine, Stob, Andrews-Purdue University).

## 1391-A2,B2, C1, C2, D3

### AEROBIC TREATMENT OF FEEDLOT RUNOFF

Department of Civil Engineering, University of Nebraska, Lincoln.
Terence J. McGhee, R. L. Torrens, and R. J. Smaus.
Journal Water Pollution Control Federation, Vol. 45, No. 9, p. 1865-1873, Sept., 1973. 4 fig. 7 tab, 14 ref.

Descriptors: *Feed lots, *Agricultural runoff, *Aerobic treatment, *Waste treatment, Cattle, Farm wastes, Physical properties, Chemical properties, Chemical oxygen demand, Biochemical oxygen demand, Liquid wastes, sludge.

The feedlot runoff used in this study was obtained from the University of Nebraska. The units were operated at liquid retention times of 1-8 days. The study was conducted at room temperature. It was determined that an aerobic biological system can effectively treat settled feedlot runoff. Reductions of chemical oxygen demand of sixty percent may be obtained. Liquid retention times of three days or more are sufficient to insure satisfactory treatment. The color of the runoff is affected slightly by aerobic treatment. Analysis of chemical oxygen demand is superior to the 5-day biochemical oxygen demand determination in evaluating the efficiency of treatment and the strength of feedlot runoff. (Cartmell-East Central).

## 1392-A11, B1, E3

### MORE BEEF ON THE HOOF: GOAL OF OHIO RESEARCH

Feedlot Management, Vol. 15, No. 11, p. 22-24, November, 1973.

Descriptors: *Ohio, *Research, *Cattle, *Productivity, Farm wastes, Recycling, Protein, Feeds.
Identifiers: *Beef, Crossbreeding, Ralgro, Selenium, Shipping fever, Diethylstilbestrol.

Research on crossbreeding, wastes, protein, Ralgro, selenium and shipping fever has been conducted by animal scientists at the Ohio Agricultural Research and Development Center. The goal was to produce animals that manufacture many pounds of quality beef as quickly and efficiently as possible. A crossbreeding project was established in 1970 to help identify the importance of breeding alternatives. The mating scheme was designed to produce straightbred Angus and Charolais cow herds. Results showed Angus calves were smaller at birth, but had a higher rate of survival and higher conformation scores at weaning. They produced more pounds of calf per unit of metabolic size than any other crosses. Feeding animal wastes has potential in starter rations for fat cattle or in rations for brood cows or ewes. Feeding trials, including protein withdrawal, have proved animals to require supplemental protein until calves weigh between 760-790 lbs. Then supplement protein can be discontinued. Three trials involving 100 heifers and 300 steers showed the performance of DES-treated cattle. Blood analyses indicated the selenium content of whole blood was increased 56 days following selenium injection. Research is still being done on selenium injections. Smith and Preston revealed a theory that protein might be a factor in shipping fever; however, results of the study were inconclusive, (Drewry-East Central).

### 1393-B3

### REDUCING LABOR DURING BROILER GROWOUT

Extension Specialist for Broiler Production, Virginia Polytechnic Institute and State University, Blacksburg.
W. D. Weaver, Jr.
Poultry Digest, Vol. 32, No. 382, p. 538-540, December, 1973. 6 fig.

Descriptors: *Automation, *Litter, *Farm wastes, Labor, Cleaning, Virginia.
Identifiers: *Broiler growout, Spreading, Feeder lids, Water jugs.

Automation today probably has had a greater impact on how broilers are raised than any other segment of agriculture. In Virginia, observations were made on tasks such as getting new litter in and old litter out of the poultry house and on filling and cleaning feeder lids and water jugs. New litter is normally delivered to the house in trucks that can be automatically unloaded. Chain-bottomed trucks can spread the litter in a window through the center of the house. From experiments, it has been found that just as good a start can be obtained without water jugs, providing that at least four eight-foot shallow "V" water troughs are supplied per 1,000 birds. Filling feeder lids has not changed much during the past years and is still done by wheelbarrow and coal bucket. However, one grower in central Virginia used a motorcycle-powered cart. Because of the increasing cost of new litter material, most companies today are practicing a built-up litter program. Under this program, houses are cleaned out once a year. Clear span houses lend themselves best to automated cleanout, although houses with posts can be adapted to most automation. Remodeling can save labor when properly done. (Drewry-East Central).

### 1394-A8, E2

### SOIL COLUMNS FOR SIMULATING ANIMAL MANURE RECYCLING

Department of Agricultural Engineering, Macdonald Campus of McGill University, Ste. Anne de Bellevue 800, P.Q., Canada.
J. R. Ogilvie, and B. P. Warkentin.
Presented at 66th Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-429, 13 p. 4 fig, 2 tab, 7 ref.

Descriptors: *Farm wastes, *Recycling, *Soils, *Waste disposal, Denitrification. Degradation (Decomposition), Chemical properties, Physical properties, Biological properties, Microorganisms, Drainage, Water, Ions, Chromatography, Chemical oxygen demand.
Identifiers: *Soil columns, *Animal manure, Loading rates, Detention time, Flux.

Soil columns were used in two studies considering applications of carbonaceous slurry material for soil recycling. The soil columns were found to be useful guides to the effect of manure recycling on soils. Since microbial denitrification and degradation of the applied manure was desired, the study of detention time was of major importance, as was maximum loading of manure slurry. The study of the flux of different solutions through the soil was instrumental in deriving response curves for these experiments. (Frantz-East Central).

### 1395-A6, A7, F2

### LEGAL ASPECTS OF ODOR AND DUST FROM FEEDLOTS

Regional Extension Specialist, Feedlot Waste Management.
M. D. Paine.
Cattle Feeders' Information, 1972, p. 7431-7434.

Descriptors: *Legal aspects, *Odor, *Dust, *Feed lots, *Air pollution, *Regulation, Zoning.
Identifiers: *Nuisance laws, Site selection, Waste management, Licenses.

Because of the current emphasis on environmental quality, all businesses, including feedlots, will become more subject to pollution regulation. A feedlot is subject to both public and private regulation. Public regulation is conducted by most states through an agency to abate, prevent, and police air pollution. These "clean air commissions" have made their initial efforts in our major cities. Private influence on air pollution occurs through the so-called "nuisance" laws All persons have the basic right to enjoy their property. Any unreasonable interference with such enjoyment is legally a nuisance. In past nuisance cases, the complaining party has asked for: (1) An injunction, (2) Damages, (3) Both an injunction and damages. There are two types of nuisances—public and private. When a feedlot is run in such a manner as to disturb the rights of a large number of people, this is said to be a public nuisance. If the rights of only a few are disturbed, this constitutes a private nuisance. Selection of a remote site may be the most important thing a feedlot can do to avoid nuisance law suits. Feedlot operation in an area zoned for agriculture does not give absolute protection against nuisance lawsuits. There are three areas of pollution law affecting agriculture which may change in the future. These are: (1) A balancing of interest test used to determine the outcome of an injunctive action, (2) Expanding the concept of legal standing so that private citizens may, in the public interest, initiate actions against "polluters" and (3) A model act to regulate animal feeding operations. (Cartmell-East Central).

### 1396-B1

### BEEF CATTLE FEEDLOT SITE SELECTION FOR ENVIRONMENTAL PROTECTION

National Animal Feedlot Wastes Research Program, Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma.
R. D. Kreis, and L. R. Shuyler.
Environmental Protection Agency Report EPA-R2-72-129, November, 1972.

Descriptors: *Feed lots, *Sites, *Cattle, Farm wastes, Regulation, Topography, Soils, Odor, Agricultural runoff, Waste storage, Waste treatment, Waste disposal, Solid wastes, Slurries, Irrigation.
Identifiers: *Selection, *Environmental protection, Spatial requirements, Microclimates.

Considerations to be made when selecting a feedlot site fall into 6 categories—regulations, spatial requirements, topographic features, microclimates, soils and geologic structures, and social considerations. While application of good site selection principles is a matter of common sense and the ability to apply existing regulations, this report does give the feedlot operator some pointers on how to deal with site selection problems, Consulting engineers and government agencies are listed which may be utilized in solving unique site selection problems. (Cartmell-East Central).

### 1397-A6, B2, B4, B5, D3

### A BEEF CONFINEMENT BUILDING WITH AN OXIDATION DITCH

Assistant to the Director, Agricultural Experiment Station, University of Illinois, Urbana-Champaign.
D. B. Bauling, W. D. Boston, and D. L. Day.
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, 12 p. 10 fig.

Descriptors: *Confinement pe[illegible] *Oxidation lagoons, *Cattle, *Farm wastes, *Waste storage, Design, Foaming, Ammonia, Odor, Aeration.
Identifiers: *Recirculating system, Slotted-floor pens.

A new cold-confinement unit for beef cattle was placed in operation on November 30, 1972, at the beef Research Farm on the Urbana-Champaign Campus of the University of Illinois. The unit was designed to receive the animal waste, aerate it for odor control and decomposition, concentrate it for storage, and finally eliminate it from the system. The unit features a totally slotted floor, an oxidation ditch, a mechanically aerated settling lagoon, and an aerobic holding lagoon. All of these are tied together in a continuous recycling system designed to dispose of all the waste without the need to clean the oxidation ditch. The experiment has shown that removal or replacement of cattle, changes in animal diets, variations in dilution or aeration rates, and changes in temperature can all adversely affect the operation of the system. Design considerations, operational problems, and general observations are given, (Cartmell-East Central).

### 1398-A2, A5, B2, C2, C3, E2

### EFFECTS OF SPREADING MANURE ON GROUNDWATER AND SURFACE RUNOFF

Research Assistant, Department of Agricultural Engineering, University of Tennessee, Knoxville.
J. C. Barker, and J. I. Sewell.
Presented at the 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-203, 10 p. 4 tab.

Descriptors: *Farm wastes, *Agricultural rupoff, *Groundwater, *Irrigation, *Waste disposal, Sampling, Biochemical oxygen demand, Dairy industry, Slurries, Physical properties, Bacteria, Nitrates, Nitrogen, Dissolved solids, Chloride.
Identifiers: *Manure, *Spreading, Saturation, Fecal coliform bacteria, Orthophosphate.

An experimental manure slurry irrigation system was established and the effects of the surface spreading of dairy manure slurry on surface runoff apd groundwater quality were studied. Grab samples of surface and groundwater were collected on several dates between May 1971 and May 1972. Bacteriological analyses were performed on the samples for both total and fecal coliform bacteria. 5-day biochemical oxygen demand tests were conducted. The dissolved solids content of the filtered samples was determined, as well as nitrate nitrogen, orthophosphate, and chloride contents. Except for isolated cases, the bacterial and chemical concentrations of water samples from an area saturated with manure slurry were within the permissable criteria for raw water for public supplies. (Cartmell-East Central).

### 1399-A5, C2

### FARM GROUND WATER NITRATE POLLUTION—A CASE STUDY

Illinois State Water Survey, Urbana-Champaign,
W. H. Walker, T. R. Peck, and W. D. Lembke.
ASCE Annual and National Environmental Engineering Meeting, Houston, Texas, October 16-22, 1972, 25 p. 8 fig, 13 ref.

Descriptors: *Groundwater pollution, *Nitrates, *Pollutant identification, *Wells, Chemical analysis, Aquifier, Septic tanks, Fertilizers, Soils, Sampling, Livestock.

A detailed study of the nature of groundwater nitrate pollution from farm-derived sources was carried out in Washington County, Illinois. Samples were taken and nitrate concentrations were expressed for different areas of the farmstead. Within the study area, 8 different nitrogen sources of pollution in the well could be identified and their effects evaluated. These were the septic tank, an old hog lot, inorganic farm fertilizer, an old chicken house, an old privy, an old horse barn and lot, an old cattle barn and lot, and nitrate fallout. As was illustrated in this study, wells located down gradient and within the flow path of nitrates or similar chemical pollution sources eventually will be adverseely affected even though several years may be required for the pollution to move through the aquifer from the source to the well. (Cartmell-East Central).

## 1400-C3, F6

### EFFECT OF CATTLE FEEDLOT VOLATILES, ALIPHATIC AMINES, ON CHLORELLA ELLIPSOIDEA GROWTH

United States Department of Agriculture, Ft. Collins, Colorado.
A. R. Mosier.
JOURNAL OF ENVIRONMENTAL QUALITY, Vol. 3, No. 1, p. 26-28, January-March, 1974. 1 fig, 3 tab, 10 ref.

Descriptors: *Feed lots, *Volatility, Algae, Toxicity, Nitrogen, Ammonia.
Identifiers: *Aliphatic amines, *Chlorella, Ellipsoidea.

The purpose of this study was to determine the effect of individual aliphatic amines that have been identified as feedlot volatiles on chlorella ellipsoidea. The amines tested were methyl, dimethyl, ethyl, diethyl, n-propyl, iso-propyl, n-butyl, and sec-butyl. Individual aliphatic amines caused a 50% reduction in population growth of chlorella ellipsoidea at concentrations ranging from 1.2 to 143 ppm amine-N. The more closely the amine structurally resembles ammonia, the greater thee inhibitory effect. The primary amines were more toxic than the sec-, iso-, or the dialkylamines. The algae could not utilize any of the amines as N sources either in the presence of adequate N or under N-deficient conditions. (Cartmell-East Central).

## 1401-E2, F2

### THREE TONS IS ALL YOU GET

WESTERN DAIRY JOURNAL, Vol. 29, No. 8, p. 12-13, June, 1973. 2 fig.

Descriptors: *Farm wastes, *Dairy industry, *Waste disposal, *Legal aspects, Cattle, Costs, Water Quality Control, Transportation.
Identifiers: *Manure.

A decision by California's Santa Ana Regional Water Quality Control Board states: The discharge of manure waste to lands owned or controlled by the discharger (dairyman) shall not exceed three tons (dry weight) per acre per year. The amount figures to the equivalent of 1.5 times the amount of manure produced by one cow in one year. The dairymen assume that if they can't put the manure on their own property, they must haul it away. But transportation and a place to haul it will be a problem. Also, the decision raises costs and could prevent dairymen from expanding herds to pay for those increases. The newest order requires dairymen to report any increase in the number of animals by 25% or 100 head-whichever is smaller. (Cartmell-East Central).

## 1402-A6, B1

### EFFECT OF WASTE MANAGEMENT AND EGG PROCESSING ON THE FLAVOR OF COOKED EGGS

Department of Poultry Science, Cornell University, Ithaca, New York.
K. R. Nath, J. M. Darfler, and R. C. Baker.
POULTRY SCIENCE, Vol. 52, No. 3, p. 1178-1185, May, 1973. 3 fig, 6 tab, 9 ref.

Descriptors: *Farm wastes, *Poultry, *Environment, Hydrogen Sulfide, Odor.
Identifiers: *Eggs, *Flavor, *Processing, *Waste management, Cryovac bags, Egg storage, Albumen, Yolk.

Four different chambers used for handling manure were compared in a study undertaken to evaluate the effect of environmental odors on the flavor of soft cooked eggs. Soft cooked eggs were prepared by immersing eggs in boiling water for four minutes. Hard cooked eggs were prepared by heating eggs for 20 minutes in water at 93°C. Some hard cooked eggs were stored in shells while other were peeled and packaged in Cryovac bags. All storage studies were done at 5°C. Hen-house environment has no effect on the flavor of soft cooked eggs. In hard cooked eggs, the flavor quality of both albumen and yolk deteriorated at one week. When eggs were peeled and packaged in Cryovac bags albumen did not deteriorate as rapidly as eggs stored in shells. The loss of $H_2S$ from cooked eggs is responsible for the loss of egg flavor. (Cartmell-East Central).

## 1403-D1, D2, E3, F3, F4

### SUMMARY OF SYMPOSIUM ON CONVERSION OF POULTRY WASTE

In: Summary of Symposium on Conversion of Poultry Waste, Lancaster Farm & Home Center, Lancaster, Pennsylvania, November 10, 1971, 60 p.

Descriptors: *Farm wastes, *Poultry, *Waste disposal, *Waste treatment, Dehydration, Recyling.
Identifiers: Conversion.

These papers were concerned with poultry manure waste management and disposal. The benefits of drying poultry manure and the potential of poultry manure recycling were explored. It was determined that a great deal of research and field testing is needed to fully develop the process of poultry waste conversion so that new products can be used, marketed or safely discharged into our environment. (Merryman-East Central).

## 1404-B3, D2, E2, E3

### 24 MILLION POUNDS OF OPPORTUNITY

Cloisterdale Farms, Incorporated, Ephrata, Pennsylvania.
G. Herr.
Summary of Symposium on Conversion of Poultry Waste, Lancaster Farm & Home Center, Lancaster, Pennsylvania, November 10, 1971, 14 p. 1 fig.

Descriptors: *Farm wastes, *Waste disposal, *Recycling, *Waste treatment, Poultry, Cattle, Hogs, Lagoons, Odor, Fertilizer, Irrigation, Dehydration, Incineration, Costs.
Identifiers: *Shud, *Agri-business, Composting, Pollution, Land spreading, Semi-dry waste, Refeeding, Community Relations.

Agri-waste not only is a problem to our environment, it also is a huge untapped resource. Many problems stand in the way of utilization of this resource, but if everyone works together, pollution caused by waste can be lessened and waste can be used beneficially. Experiments at Cloisterdale Farms have indicated that even large operations can handle their waste by graduallly converting waste to semi-dry; thus reducing waste moisture to 28-35%. Odor free semi-dry waste can then be hauled off and spread on land. Also, possible dehydraation might lead to fertilizer products, re-feeding, composting or other uses of waste. Conclusions indicate that liquid handling; be it lagoon, irrigation or hauling would not be the long range answer to disposal problems. Getting rid of the waste is not just a problem; getting rid of it profitably is an opportunity. (Russell-East Central).

## 1405-A6, B3, D1, D2, F1

### MANURE REDUCTION AND CONVERSION METHODS OF THE FUTURE

Department of Poultry Science, Pennsilvania State University, University Park, Pennsylvania.
G. O. Bressler.
Summary of Symposium on Conversion of Poultry Waste, Lancaster Farm & Home Center, Lancaster, Pennsylvania, November 10, 1971, 4 p.

Descriptors: *Farm wastes, *Dehydration, *Waste treatment, *Poultry, Drying, Environment, Anaerobic bacteria, Odor.
Identifiers: Manure, Drying pits.

Pennsylvania State researchers have been invesigating dehydration of manure as an economic solution to waste problems and have developed a two-stage drying system. In stage one, the use of high velocity air movement and mechanical stirring of the manure in the pit reduces each 2.9 tons of manure to 1 ton, a reduction of about 3 to 1. The resulting manure can be easily transported with a minimum of odors. Stage two dries the remaining manure in a dryer to a moisture level of about ten percent. The result is a fine, dry manure product, free from offensive odors and able to be stored without deterioration or odor formation. Dehydration offers the best hope for the future. Not only does this method have the advantage of reducing the quantity of material and offensive odors, its influence on improvement of the poultry house environment may show additional benefits. Working conditions for the caretaker would also be improved. These advantages may very well off-set some of the costs of handling manure by the dehydration method. (Russell-East Central).

## 1406-A6, A10, A11, B1, E1, E3, F1

### ECONOMICS OF MANURE HANDLING

Department of Agricultural Economics, Pennsylvania State University, University Park.
A. P. Stemberger.
Summary of Symposium on Conversion of Poultry Waste, Lancaster Farm & Home Center, Lancaster, Pennsylvia, November 10, 1971, 1 p.

Descriptors: *Farm wastes, *Poultry, *Conversion, Waste disposal, Cost analysis.
Identifiers: *Waste management.

Data was collected by personal interview of managers of egg production enterprises and by observation of operations whenever possible. Information was collected regarding type of waste disposal systems used, investment necessary, operating costs, labor required, odor and insect problems, methods and frequencey of manure removal and disposal, size of operation and performance of layers. This information is being analyzed to determine costs of handling and removing manure from egg laying houses by various methods. An investigation of costs of methods of processing raw manure into saleable products, size of market, and estimation of demand for poultry manure products is being conducted. The objective is to determine manure handling costs for various systems. Naturally, the industry is interested in methods with the least cost. But, they also realize that the least-cost system of handling manure may not always be the best one. They are striving to find a system that does not affect layer performance and produces a desired saleable end product. After careful study of specific operations, results will have to be used with caution. (Russell-East Central).

### 1407-A1, A6, B3, D1, E2 F1

### MODIFY YOUR POULTRY HOUSE FOR MANURE DRYING

Poultry Science Extension, Pennsylvania State University, University Park.
F. W. Hicks.
Summary of Symposium on Conversion of Poultry Waste, Lancaster Farm & Home Center, Lancaster, Pennsylvania, November 10, 1971, 6 p.

Descriptors: *Modification, *Farm wastes, Poultry, Drying, Dehydration, Waste treatment, Waste disposal, Odor, Ventilation, Air conditioning, Environmental control, Lagoons, Aerobic bacteria, Anaerobic bacteria.
Identifiers: *Poultry house, *Manure, *In-house drying.

A lot of material is being written about efficient and practical waste handling, but no one has devised the system which could be considered the final answer to poultry housing and waste management. It seems that drying or dehyration is the best answer, and one easily utilized drying method is from the ventilation system within the poultry house. The partially dried waste could then be spread on land, allowed to be broken down by bacteria, or stored. In-house drying also reduces odors significantly, and usually very little house modification is necessary. No matter what type of waste handling system is used, it must be: (1) Socially acceptable to neighbors, (2) Economically feasible and practical, (3) Mechanically possible and simple, (4) Legal according to local and federal regulation. If at all possible, waste should be disposed of in such a way that it may be recycled to avoid a drain on natural resources. (Russell-East Central).

### 1408-A11, B3, E3, F1

### THE ECONOMICS OF RECYCLING CONVERTED POULTRY WASTE THROUGH CATTLE

Department of Animal Science, Pennsylvania State University, University Park.
T. L. Long.
Summary of Symposium on Conversion of Poultry Waste, Lancaster Farm & Home Center, Lancaster, Pennsylvania, November 10, 1971, 6 p. 2 tab.

Descriptors: **Farm wastes, *Poultry, *Economics, *Recycling, *Waste disposal, Litter, Organic matter, Proteins
Identifiers: *Wastelage, *Refeeding, Ensilage.

Experiments have shown that poultry manure and litter fed to cattle as part of a balanced ration can give satisfactory results. Poultry waste is especially good as a protein supplement for ruminants, because rumen microorganisms are able to utilize the nitrogenous compounds of the manure and synthetize bacterial protein which can then be utilized by the host animal. Many factors favor use of poultry waste as a feed. It would be an economic and efficient use of a huge resource and would remove the large problem of waste management. Experiments were conducted on Hereford steers to evaluate nutritional and economic feasibility of using fresh poultry excreta as a major component of wastelage. Three growing rations calculated to support 1.65 pounds of body weight gain per day were devised and cost per hundred pounds of gain calculated. When results were tabulated, it was found that while all rations gave economical gains, it would have cost about 45% less per hundred pounds gain when the cattle were fed corn wastelage as compared to alfalfa hay. (Russell-East Central).

### 1409-A11, B3, C2, D3, E3

### SOME POTENTIAL USES FOR DEHYDRATED POULTRY WASTES,

Poultry Science Extension, Pennsylvania State University, University Park.
O. D. Keene,
Summary of Symposium on Conversion of Poultry Waste, Lancaster Farm & Home Center, Lancaster, Pennsylvania, November 10, 1971, 11 p. 4 tab, 15 ref.

Descriptors: *Farm wastes, *Poultry, *Dehydration, *Recycling, *Waste treatment, *Waste disposal, Nutrition, Nitrogen, Proteins, Ruminants, Bacteria, Insects.
Identifiers: *Refeeding, Uric acid, Environmental protection.

Disposing of poultry waste is a problem which is increasing in magnitude. Recycling as feed offers promising results to researchers. Inclusion of poultry manure into diets of ruminants has been reported by many investigators, and ruminants apparently can use many of the ingredients found in poultry wastes. However, incorporation of manure into the diets of poultry has had limited success. The major basis for this is uric acid. Uric acid apparently is detrimental to poultry by acting as an irritant in the intestinal tract. Due to experiments, it seems apparent that refeeding poultry manure back into poultry has very limited possibilities. Research into other areas of disposal is also being conducted. Insect disposal of waste is one possibility, but much study needs to be done before we engage in large scale use of insects. Also bacterial fermentation is a possible avenue for disposal. No matter what the method there will be problems, but perhaps a feasible working solution will result from further research and study. (Russell - East Central)

### 1410-B1, D1, D2, D3, E1, F2

### LIVESTOCK WASTE MANAGEMENT SYSTEM DESIGN CONFERENCE FOR CONSULTING AND SCS ENGINEERS,

Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 303 p.

Descriptors: *Livestock, *Design criteria, *Engineering, Legal aspects, Farm wastes, Waste treatment, Waste disposal, Agricultural runoff.
Identifiers: *Waste management, pollution.

This conference was conducted in order to bring together those concerned with feedlot waste storage, treatment and disposal systems. Actual USDA-SCS guides drawn to Nebraska engineering standards and specifications for livestock-waste control were included. (Marquard-East Central)

### 1411-B1, F2

### RULES AND REGULATIONS PERTAINING TO LIVESTOCK WASTE CONTROL,

Presented at Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 13 p.

Descriptors: *Regulation, *Legal aspects, *Livestock, *Waste treatment, *Waste disposal, Nebraska, Farm wastes, Permits, Groundwater, Water pollution.
Identifiers: *Rules, Registered municipal wells.

Nebraska rules and regulations concerning livestock waste control are delineated. Pertinent terms are defined; permit requirements are outlined; and requirements for livestock waste control facilities are given. A list of the registered municipal wells in Nebraska is included. Also listed, are the towns that have been issued permits to withdraw and use groundwater. (Marquard-East Central).

### 1412-A2, B2, C1

### HYDROLOGIC AND HYDRAULIC CONSIDERATIONS FOR DESIGN OF LIVESTOCK WASTE MANAGEMENT SYSTEMS,

United States Department of Agriculture Lincoln, Nebraska.
N. P. Swanson.
Presented at Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 18 p. 2 fig. 1 tab, 26 ref.

Descriptors: *Livestock, *Design, *Farm wastes, *Agricultural runoff, Feed lots, Waste storage, Odor, Terracing, Nitrates, Rain, Slope, Solid wastes, Nebraska.
Identifiers: Waste management systems.

A discussion is given on hydrologic factors which are pertinent to potential pollution from feedlots. Experiments with a rainfall simulator produced solids losses as high as 10.7 and 27.9 tons per acre foot of runoff on an 8.5 percent slope. 12% slopes produced as high as 40.5 to 66 tons of solids per acre foot. Snowmelt causes a higher concentration of suspended solids. Solids transported by runoff and collected in a holding pond pose three problems: (1) pond storage capacity is reduced (2) emptying the pond by pumping is more difficult and (3) accumulation of solids causes odors. These problems may be overcome by terracing and lowering of slope. (Marquard - East Central)

### 1413-A2, B2, B4

### FEEDLOT RUNOFF CONTROL SYSTEM DESIGN AND INSTALLATION—A CASE STUDY

Agricultural Research Service
United States Department of Agriculture
Agricultural Engineering Research Division
University of Nebraska, Lincoln
C. B. Gilbertson, and J. A. Nienaber.
Presented at Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 16 p. 4 fig. 3 tab, 19 ref.

Descriptors: *Agricultural runoff, *Feedlots, *Control systems, *Design, *Installation, Water pollution, Farm wastes, Cattle, Waste treatment, Waste storage, Waste disposal, Continuous flow, Settling basins, Solid wastes, Nebraska.
Identifiers: *Debris basin, *Holding pond, Settleable solids,

A case study was made for a 1000-head beef feedlot for the design and installation of a debris basin, holding pond and disposal area for controlling runoff. Design equations were formulated. The continuous flow system removed solids successfully in the debris basin. Solids transported by snowmelt and rainfall were 2.6 and 1.8 tons per acre respectively. The debris basin removed 50% of these solids. Problems of wood board swelling developed with the discharge control from the debris basin to the holding pond. The use of tile will prevent this problem. It is recommended that the holding pond capacity be increased to 100% of the ten-year twenty-four hour storm when the feedlot represents a high pollution threat to the surrounding area. (Marquard - East Central).

### 1414-A8, B2, E2

### SPRINKLER APPLICATION OF LIQUID WASTES FROM HOLDING PONDS,

Howard Wittmuss
Presented at Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 7 p. 4 tab.

Descriptors: *Waste disposal, *Liquid wastes, Chemical properties, Nitrogen, Effluent, Cattle, Feed lots, Fertilizers, Phosphorus, Nebraska.
Identifiers: *Holding ponds, *Sprinkler applications, Chlorine.

A research study concerning disposal of liquid wastes was conducted at Nebraska's Mead Field Laboratory. The study included three replications each of effluent application, fresh water application and a check (no water application) in sod planted corn. One half of each plot received 200 pounds of nitrogen fertilizer as ammonium nitrate and the other half was unfertilized. The effluent and water were applied at a graded rate from 1 inch to 3 inch applications on the same plot area. Soil moisture, soil density, soil chemical analysis, effluent analysis, deep percolate analysis, crop yield, and crop chemical analysis data was collected during the year. Results indicated that effluent could be disposed of in corn fields by sprinkler at a rate of 10 inches a year for maximum benefit from the effluent. (Merryman - East Central).

## 1415-A2,A4,A5,A6,B1,E2,F4

### HOW TO GUARD AGAINST POLLUTION FROM BEEF CATTLE FEEDLOT WASTES,

United States Department of Agriculture
Lincoln, Nebraska
T. M. McCalla, and G. E. Schuman
Presented at Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 9 p. 4 tab, 19 ref.

Descriptors: *Farm wastes, *Cattle, *Water pollution, *Agricultural runoff, *Feed lots, Groundwater pollution, Waste treatment, Waste disposal, Nitrogen, Odor, Nebraska.
Identifiers: *Pollution, Effluent application, Waste management.

A description is given for the factors involved in water pollution from feedlots. A literature survey covers the topics of runoff, groundwater pollution, effluent application, feedlot management, odors, land utilization, housed feed lots and microbial pollution. It was concluded that no matter what waste management design is used, management of the system is the key factor. The less maintenance or attention required by the feeder, the better. (Marquard-East Central).

## 1416-A2, B2, B4, D3, E2

### DAIRY AND SWINE WASTE SYSTEMS

E. A. Olson
Presented at Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 6 p. 3 fig.

Descriptors: *Farm wastes, *Dairy industry, *Cattle, *Hogs, *Waste treatment, *Waste disposal, Septic tanks, Agricultural runoff, Design, Design criteria, Nebraska,
Identifiers: *Waste systems, *Waste management, Holding pond.

Three systems are given for handling dairy wastes. System A takes milkroom and toilet wastes to an aerobic lagoon. The lagoon size should be five feet deep and have 50-60 square feet of surface area per cow. A holding pond is used to collect runoff from the lot. In system B, all wastes except washroom and toilet go to a holding pond. The holding pond is emptied as required. The washroom and toilet wastes go to a septic tank and then field disposal. System C is the same as B except it replaces the holding pond with a closed storage tank which has a 120 day storage capacity. Regardless of disposal method, the dairyman must have his plans approved by the Bureau of Dairies and Foods to keep a Grade A dairy standing. Swine wastes can be handled in the same manner. Holding pond capacity should be 34.5 cubic feet per hog. (Marquard - East Central).

## 1417-A2, B2, B3, B4, E2

### LIVESTOCK WASTE MANAGEMENT SYSTEMS—MANAGEMENT AND MAINTENANCE DESIGN CONSIDERATIONS

United States Department of Agriculture, Lincoln, Nebraska.
N. P. Swanson and L. G. Jackson,
Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 6 p.

Descriptors: *Livestock, *Cattle, *Management, *Maintenance, *Design, *Feed lots, Agricultural runoff, Solid wastes, Liquid wastes, Irrigation systems, Nebraska, Waste storage, Waste treatment, Waste disposal, Effluent.
Identifiers: *Waste management, Pollution.

In order to properly maintain a feedlot, one must include planning for emergencies. There should be a means of feeding the cattle and cleaning the feedlot during inclement weather. The feedlot holding pond should have enough capacity to hold a 10-year storm. For solid waste management, land application for manure is an acceptable practice. Application rates should be based on soils, crops, and cultural practices. 1.5 tons of manure per animal per year can be expected. Mounding may be used to dispose of solids and to improve bedding areas for cattle. Debris basins provide solid waste storage, but must be cleaned when accumulations reach 6 to 8 inches. For liquid waste disposal, irrigation is the only method now recommended in Nebraska, 10 inches of runoff per year can be expected in Nebraska and may be applied by flooding, furrow or sprinkler irrigation. (Marquard - East Central).

## 1418-A2, B2, B4

### TYPICAL AND UNIQUE DISPOSAL SYSTEMS SURFACE DRAINAGE

United States Department of Agriculture, Lincoln, Nebraska.
N. P. Swanson.
Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 2 p. 1 fig.

Descriptors: *Farm wastes, *Waste disposal, *Feed lots, *Surface drainage, Agricultural runoff, Slopes, Groundwater pollution, Waste storage, Drainage, Basins, Nebraska.
Identifiers: Mounding.

Surface drainage on a level feedlot is a constant problem. Manure accumulation at T. C. Reeves farm had reached 12 to 15 inches and was causing problems. To solve the problem, mounds were constructed and a moderate slope was built into drainways between the mounds. The drainage was passed on to three shallow basins which were connected by underground lines to a sump. Due to possible groundwater pollution, the runoff was pumped from the sump to an underground polyethylene-lined holding pond. Heavy rains in the summer of 1972 and a wet winter have proven the value of this drainage system. (Marquard - East Central),

## 1419-A2, B2, E2

### RUNOFF CONTROL FOR A CREEK BANK FEEDLOT

United States Department of Agriculture
Lincoln, Nebraska
N. P. Swanson
Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska.

Descriptors: *Livestock, *Farm wastes, Waste treatment, Waste disposal, Legal aspects, Nebraska.
Identifiers: *Waste control facilities, *Guidelines, Permits, Pollution, Soil Conservation Service, Nebraska Department of Environmental Control.

Unless it is controlled, runoff from a feedlot on a flood plain or creek bank is a potential source of pollution. However, many times relocation of the feedlot by the owner is not feasible. One feedlot owner met this pollution problem by installing a ten foot high dike along the lower side of the feedlot next to the creek. The dike prevented runoff contamination of the water and flooding of the creek. It also provided comfort for the animals. Runoff from the feedlot was collected in a basin. Three riser inlets drained the basin into a sump. From there, the water was pumped to a holding pond from which it is spread as irrigation water to field crops. (Marquard-East Central).

## 1420-B1, F2

### GUIDELINES ON LIVESTOCK WASTE CONTROL FACILITIES

Nebraska Department of Environmental Control, Lincoln
Livestock Waste Management Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 12 p.

Descriptors: *Livestock, *Farm wastes, Waste treatment, Waste disposal, Legal aspects, Nebraska.
Identifiers: *Waste control facilities, *Guidelines, Permits, Pollution, Soil Conservation Service, Nebraska Department of Environmental Control.

The steps required for obtaining a permit for livestock operations where pollution potential exists are given. Basically, the operator must first request a permit:. The Department of Environmental Control then makes an inspection. If no controls are needed the permit is issued. If controls are needed, the Soil Conservation Service engineers design the controls and the operator places them into operation. Then the permit is issued. Samples of the forms to be filled out are included. (Marquard-East Central).

## 1421-B1, F4

### COORDINATED LIVESTOCK PRODUCTION SYSTEMS

United States Department of Agriculture, Lincoln, Nebraska.
N. C. Teter, and C. B. Gilbertson.
Livestock Waste Management System Design Conference for Consulting and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 10 p. 4 tab.

Descriptors: *Livestock, Farm wastes, Cattle, Hogs, Waste disposal, Design criteria, Feeds, Waste storage, Lagoons, Odor, Irrigation systems, Performance.
Identifiers: *Coordinated production systems, Water systems, Electrical power systems.

This paper discusses the components necessary for designing a complete livestock production unit. Specific publications are recommended which will aid in designing water systems, feeding systems, and waste management systems. All variables should be coordinated in order to create a total system that is easy to manage. Even the best designed system will fail if it is not properly managed. (Marquard-East Central).

## 1422-A2, A4, A5, A6, B2, B3, D2, D3, F1

### AN ANALYSIS OF BEEF CATTLE FEEDLOT DESIGNS FOR POLLUTION CONTROL

Agricultural Engineering Research Division, Agricultural Research Service, Lincoln, Nebraska.
C. B. Gilbertson.
Livestock Waste Management System Design Conference and SCS Engineers, Lincoln, Nebraska, February 15-16, 1973, 8 p. 2 tab. 6 ref.

Descriptors: *Feed lots, *Design, *Analysis, *Waste treatment, *Waste disposal, Farm wastes, Costs, Odor, Oxidation lagoons, Water pollution, Design Agricultural runoff, Incineration.
Identifiers: *Pollution control, Mounding, Paved feedlots, Unpaved feedlots, Housed feedlots, Composting.

Feedlot waste management alternatives of paved, unpaved and housed feedlots are discussed. Alternatives which are listed are mounding, composting, incineration, oxidation ditches and mechanical scraping. The physical requirements for each system are given. The method to be used will vary considerably with the cattle density; however, these observations can be made: (1) odor problems will limit outdoor feedlots in the future, (2) high labor costs and discomfort to cattle will limit development of paved feedlots, (3) housed feedlots will increase in the future due to high labor cost and pollution problems of outdoor feedlots, (4) for a housed feedlot unit, the costs of structure is about 30% of the total materials costs, and (5) use of oxidation ditches with housed feedlots will increase materials' costs by 17 to 20%. (Marquard-East Central).

### 1423-A4,A5,A12,C3,D1,D2
### AFLATOXIN FORMATION IN STERILIZED FEEDLOT MANURE AND FATE DURING SIMULATED WATER TREATMENT PROCEDURES
Department of Microbiology
Colorado State University
Ft. Collins
D. A. Hendrickson, and D. W. Grant.
Bulletin of Environmental Contamination and Toxicology, Vol. 6, p. 525-531, November-December, 1971. 3 tab. 7 ref.

Descriptors: *Farm wastes, *Water treatment, *Feed lots, *Water pollution, *Groundwater pollution, Agricultural runoff, Microorganisms, Toxicity, Cattle, Decomposing organic matter, temperature.
Identifiers: *Aflatoxin, Sand filtration, Chlorination.

A study was undertaken to: evaluate cattle feedlot manure during various stages of decomposition as a substrate for aflatoxin formation of surface and ground water supplies; and determine the fate of the aflatoxin during simulated water treatment procedures. It was found that 0.2 mg per kg of aflatoxin B was formed in fresh and partially decayed manure, while only 0.01 mg per kg was formed in stockpiled manure. Similarly, aflatoxin G was found in small amounts in the partially decayed manure and was absent from the stockpiled manure. The lowest temperature permitting aflatoxin formation in autoclaved fresh manure was 10 to 15 C, while the upper limit was 37 to 41 C. It is concluded that fungal growth and toxin formation in decomposing manure are naturally modified by the growth of a varied microflora, although under proper conditions stockpiled feedlot wastes may serve as substrates for aflatoxin formation. Therefore, it is likely that the aflatoxins formed in the wastes could, via runoff and leaching, contaminate water destined for domestic use, thereby necessitating the application of precautionary decontamination measures. Both sand filtration and chlorination of aflatoxin-contaminated water were found effectiva in removing or inactivating the contaminants, and the application of one or both during all water treatment processes is recommended. (Solid Waste Information Retrieval System).

### 1424-A2, B2, B4, C1
### BEEF CATTLE FEEDLOT RUNOFF—PHYSICAL PROPERTIES
Agricultural Research Service, United States Department of Agriculture, Nebraska University, Lincoln.
C. B. Gilbertson, and J. A. Nienaber.
Transactions of the ASAE, Vol. 16, No. 5, p. 997-1001, Sept.-Oct., 1973, 3 fig., 7 tab., 13 ref.

Descriptors: *Agricultural Runoff, *Feed lots, *Cattle, *Farm wastes, *Physical properties, Chemical properties, Sampling.
Identifiers: *Runoff control, Solids.

This paper represents basic information of feedlot runoff for enhancing and simplifying design of runoff control facilities. Three runoff control facilities were constructed and instrumented on feedlots with a capacity of 200 head each. Two additional runoff control facilities were installed with 1000-head capacity. Automatic runoff samplers were installed on all sites to obtain composite samples of runoff from the feedlots and on effluent discharged from the debris basins to the holding ponds. Laboratory analyses were run and total solids concentration, settleable solids, and nonfiltrable solids were determined. These data may be valuable in calculating detention times and storage capacities for solids settling facility design. The results can also be used to calculate solids accumulations in holding ponds to estimate maintenance requirements. (Cartmell-East Central).

### 1425-B1, F4
### AN ANNOTATED BIBLIOGRAPHY OF FARM ANIMAL WASTE MANAGEMENT
Water Pollution Control Directorate
Environmental Protection Service
J. B. McQuitty, and E. M. Barber.
Environmental Protection Service Report Number EPS 3-WP-72-1, December, 1972, 322 p.

Descriptors: *Farm wastes, *Bibliography.

This monumental volume contains 2352 abstracts of material which appeared (with very few exceptions) between 1960 and 1971. The classifications adopted and the number of abstracts in each class is as follows:

| | | |
|---|---|---|
| A. | Abstracting journals and bibliographies | 641 |
| B. | Scientific and technical journals | 678 |
| C. | Conference proceedings | 351 |
| D. | Books and monographs | 58 |
| E. | Government, research center, and university publications | 318 |
| F. | Semi-technical publications | 110 |
| G. | Unpublished scientific and technical papers | 196 |

(Whetstone, Parker, & Wells-EPA)

### 1426-C1, C2, C3, D1, D2, D3, E2, E3
### INDUSTRIAL WASTES - RESEARCH AND PRACTICE IN ANIMAL WASTES TREATMENT
Tippecanoe Laboratries
Eli Lilly & Co.
Lafayette, Indiana
R. H. L. Howe
Water & Wastes Engineering, Vol. 6, No. 1, p. A14-A18, January 1969. 7 fig, 7 tab, 6 ref.

Descriptors: *Farm wastes, *Waste treatment, *Water pollution, On-site investigations, Chemical properties, Physical properties, Waste disposal, Livestock, Biological treatment, Liquid wastes, Solid wastes.
Identifiers: *Animal processing wastes, Slaughterhouse.

To investigate animal wastes problems, it is necessary to determine the quantity of wastes produced by each animal and the important characteristics of the wastes. Charts are furnished to show the composition and characteristics of animal, human, slaughterhouse and packinghouse wastes. Once the quantity and characteristics are established, effective and economical methods can be developed to serve industries and to help reduce the water pollution load caused by animal production. It has been found that solid wastes and liquid wastes must be separated and handled differently for reasons of economy. The liquid wastes are collected and treated by aerobic oxidation, biological adsorption, and flocculation followed by clarification and filtration. In one case, a three stage biological treatment is required for stabilizing the liquid. The merits of this system are: low cost, minimum operation with flexible capacity and control, maximum safety, and high efficiency. The treated effluent can be used for irrigation and other agricultural or industrial purposes. Physical and chemical methods of animal wastes treatment are also being investigated. The treatment of animal processing wastes involves the following steps: separation of suspended solids and grease from the liquid; chemical coagulation and clarification of the clarified liquid; and chlorination and oxygenation of the final treated effluent. The processes are discussed in detail. (Solid Waste Information Retrieval System).

### 1427-B3, D1, D2, E3, E4
### THE SOCIAL REDEMPTION OF PURE GARBAGE
J. Solomon
Sciences, Vol. 12, No. 6, p. 13-15, July-August, 1972.

Descriptors: *Reclamation, *Wastes, California, Anaerobic digestion, Methane, Fuels, Gasses
Identifiers: *Garbage, *Pollution, Chlorine, Sulfur

Intriguing possibilities for converting garbage into fuel are outlined. If garbage were efficiently converted to power, it could furnish up to 6 percent of total U. S. energy needs. Each pound of garbage can supply 3,000 to 6,000 BTU of heat. One company fed pulverized refuse into a power generating station. Waste provides 10 percent of the energy fired. In another process, solid waste is reduced in size and fed to a pressurized, fluidized bed combuster. Hot gasses are cleaned of particulates and passed through a gas turbine to produce electricity. In both cases, however, chlorine produced in the off-gasses is a potential pollutant. A corporation in California is attempting to produce oil, fuel gas, and solid char by exposing solid waste to iron removal processes, air classification, shredding., and pyrolysis. Another firm reacts solid waste with carbon monoxide in the presence of sodium carbonate to yield low-sulfur fuel. If all of the nation's animal wastes were treated by anaerobic digestion, half of the current methane consumption would be produced. (Solid Waste Information Retrieval System)

### 1428-A11, E3
### RECYCLE ORGANIC WASTES AS FEED FOR MEAT ANIMALS
Compost Science, Vol. 12, No. 6, p. 19, November-December, 1971.

Descriptors: *Waste disposal, *Recycling, *Farm wastes, *Organic wastes, *Feeds, Livestock, Nutrients, Sawdust, Fertilizers
Identifiers: Meat

Zoologists at Penn State University have been experimenting with feeding farm animals on several forms of organic wastes, most of which are of nutritional value. When adequately supplemented with protein, vitamins and minerals, wastes can serve as excellent animal feeds as well as easing disposal problems in a manner which is more economically feasible than is spreading them on fields as a fertilizer. Now that DDT is no longer used on orchard trees, apple pomace should be fed to ruminants, for whom it is a satisfactory energy source. Ground waste paper soaked in blackstrap molasses was readily eaten by ruminants, as was sawdust, a roughage substitute which seems to contribute to lower rates of liver abscesses. Finishing rations containing sterilized poultry wastes had no effect on weight gain, meat, carcass quality, or any other factors under study. None of these feeds produced unacceptable levels of arsenic, chlorinated hydrocarbons, or pesticides in meat, fat, or liver tissue. Although consumer acceptance is one stumbling block to such a feed program the technology for this form of waste utilization is already available. (Solid Waste Information Retrieval System)

### 1429-B2, C1, C2, D3, E2
### IN-THE-BUILDING OXIDATION DITCHES FOR LIVESTOCK WASTES
Agricultural Engineering Department
Illinois University
Urbana-Champaign
D. L. Day
Water & Wastes Engineering, Vol. 7, No. 9, p. E-23-E-24, September 1970.

Descriptors: *Farm wastes, *Livestock, *Waste treatment, Aerobic treatment, Effluents, Nitrates, Biochemical oxygen demand, Odor, Phosphates, Lagoons, Waste storage, Waste disposal

Identifiers: In-the-building oxidation ditches, Biological oxidation, Land disposal

Aerobic treatment for the removal of biodegradable organic matter from liquid wastes is an odorless process consisting of two phases operating simultaneously. One phase is biological oxidation that gives by-products such as carbon dioxide and water, and yields energy. The second phase utilizes the energy from the oxidation for synthesis of new cells. The in-the-building ditch for livestock wastes is a completely mixed aerobic system having a long detention time. The ditch is located beneath the self-cleaning slotted floors in a confinement building. The liquid volume is about 30 cu ft/pound of daily BOD5. The liquid is shallow to keep the solids suspended. The depth is kept constant by using an overflow for the mixed liquor. After the bioxidation system comes to equilibrium, the mixed liquor BOD5 will typically be 3,000 to 5,000 mg/L, resulting in a BOD5 reduction of about 90 percent. A low-labor waste treatment system can be formed by allowing the oxidation ditch liquor to overflow by gravity into a non-overflow aerobic lagoon with a fluctuating depth. The effluent is not suitable for direct discharge into a stream, but may be spread on land in an odorless state. Some obvious concerns of this system are: nitrates in the effluent disposed on the field; possible consequences of high rates of application to fields; nitrates, phosphates, and color of the effluent if stream discharge were to be used; and operating costs. (Solid Waste Information Retrieval System)

### 1430-D3, E3
### CHANGING FROM DUMPING TO RECYCLING. PART 2. ORGANIC WASTES

Sanitary Engineering Research Laboratory
University of California
Berkeley
C. G. Golueke
Compost Science, Vol. 13, No. 2, p. 20-23, March-April, 1972.

Descriptors: *Recycling, *Organic wastes, *Waste treatment, Feeds, Chemicals, Ponding, Anaerobic digestion, Activated sludge, Trickling filters, Stabilization, Oxidation lagoons
Identifiers: Pyrolysis, Fermentation, Soil, Manure

Methods of recycling the major groups of organic wastes (such as food processing or cannery, packing plant or slaughterhouse, manure, and wood wastes) are discussed. Their recycling creates three major products: soil, foodstuffs, and useful chemicals. The present treatment methods, concentrating on elimination of wastes rather than reclamation, are reviewed. Ponding is accomplished using anaerobic ponds, facultative ponds, oxidation ditches, and high-rate ponds. The treatment mechanism in the trickling filter is aerobic-biological stabilization of organic wastes suspended or dissolved in water. The activated sludge works on the same principle; it differs from the trickling filter process because no surfaces are provided for the attachment of a microbial layer; it is a compact process, subject to fairly close control. The anaerobic digestion process differs from the preceding processes (except the anaerobic pond), as biological decomposition takes place in the absence of oxygen. (Solid Waste Information Retrieval System)

### 1431-D2, E3, F1
### ANOTHER RECYCLING VENTURE

Calf News, Vol. 11, No. 4, p. 15-16, April, 1973. 2 fig.

Descriptors: *Recycling, *Fermentation, *Anaerobic conditions, *Farm wastes, Amino acids, Feeds, Fuels, Cattle, Feed lots, Gases, Methane, Carbon dioxide, Costs, Waste treatment, Waste disposal
Identifiers: Thermophilic

Hamilton Standard initiated an experiment in December of 1970 to determine the feasibility of converting animal wastes into usable by-products by anaerobic fermentation. At the time of this report, two twenty-liter fermenters had been used for 1½ years. The operating temperature was in the thermophilic range and the feed material was animal waste obtained from cattle fed a high concentrate ration. Tank volumes of only 1/3 that of municipal systems were deemed practical. The system utilized very thick waste concentrations, operated with high process loading rates and small fermenter volumes, had low power requirements and generated its own fuel. Advantages of the process were: (1) It produced two products (fuel and animal ingredients) which could be used in the feedlot operation. (2) It would accept all of the solid wastes in the form available. (3) It had no discharges of liquid, solid, or gaseous pollutants. This study showed the anaerobic process to require two-thirds the capital investment and one-half the annual operating expense compared to the aerobic process. (Lee-East Central)

### 1432-D3, E3
### COMPOSTED MANURE CALLED 'AVAILABLE FUEL SOURCE,'

Feedlot Management, Vol. 16, No. 4, p. 28, 30, April 1974. 1 fig.

Descriptors: *Farm wastes, *Fuels, *Recycling, *Waste treatment, *Waste disposal, Aerobic bacteria, Thermophilic bacteria, Sulfur, Organic wastes, Pathogenic bacteria, Moisture content, Odor, Energy,
Identifiers: *Compost, *Manure, Pyrolysis

A method of converting the nation's animal wastes into usable sulfur-free fuels through a rapid composting process has been proposed as a way to ease the energy crisis. Three billion tons of organic wastes are produced each year. If all these were available, they could be converted to ¼ of our natural gas requirements. Manure doesn't lend itself to easy burning unless it is composted because of high moisture content. The action of thermophilic, aerobic bacteria produces heats high enough to drive off the moisture and kill pathogenic bacteria. The resulting product is safe, stable and easy to store. 15 to 28 BTU's are created for each BTU expended and the composted fuel can be added to other fuels to create higher energy levels. (Lee-East Central)

### 1433-A11, B1, E3
### PERPETUAL-MOTION RECYCLING, OR, PIG MANURE INTO FISH FOOD

M. Franz
Compost Science, Vol. 12, No. 5, p. 21, September-October 1971. 1 fig.

Descriptors: *Recycling, *Farm wastes, *Livestock, *Hogs, *Feeds, *Fish farming, *Fish diets
*Fish food

A system has been proposed for recycling the 1,000,000,000 tons of animal manures generated in the United States each year. The manures are dumped into ponds where they stimulate the rapid growth of the plant life on which some fish feed. The fish can then be harvested for human consumption. Also, an aquatic plant species, Ipomoca repens, which is a suitable pig feed, can grow rapidly in the manure-fertilized ponds. A pig farm in Malaya flushes the manure from 700 pigs into eight fish ponds, covering 2¼ acres, and stocked with Siberain white Amur and Tilapia mossambica. About 9,000 lb of fish were produced in the first year, and up to 1,250 lb of Ipomoca repens can be harvested daily in peak seasons. The white Amur, buffalo fishes, and Tilapia have all been successfully farmed using this system, and all are considered highly desirable for humans. Several species of shellfish, large freshwater shrimp, and silver and spotted Amur are also being considered as potentially adaptable to the system, both animal waste and idle-land problems can be economically solved. (Solid Waste Information Retrieval System)

### 1434-B2,B3,D1,D2,D3,E2,E3
### ENERGY NEEDED TO MANAGE ANIMAL WASTE

Electrical World, Vol. 178, No. 5, p. 70-72, September 1, 1972. 2 fig.

Descriptors: *Energy, *Farm wastes, *Management, *Recycling, *Waste treatment, *Waste disposal, Feed lots, Feeds, Drying, Spreading, Irrigation, Lagoons, Aeration.
Identifiers: *Animal waste, Pyrolysis

As the demand for some form of animal waste handling grows, so will the demand for energy necessary to drive these systems. The most popular way of dealing with animal waste today is to incorporate air into liquid wastes. Processes of this type use aeration wheels, discs, or aeration pumps and are generally electrically powered. Floating aerators, sprinkling systems, and oxidation ditches require substantial amounts of energy since they typically use 3-hp motors for each aeration unit. Animal wastes can also be dried and sold; the market at present for dried manure is very good. This process too requires heat energy from some source, as does pyrolysis, a means by which manure has been successfully converted into a range of products including crude oil, natural gas, and treated manure. Recycling of animal wastes as feed for the beasts that produced the manure in the first place probably holds more potential than almost any other recent feeding discovery. The basic requirement for the conversion of manure to feed is heat to promote the thermophilic bacterial reaction involved. Another popular concept—returning the wastes to land—will necessitate either electrical or internal-combustion power supplies to operate the sprinkler systems and pumps. (Solid Waste Information Retrieval)

### 1435-A3,A4,A5,A11,A12,B1, C2,E2
### AVAILABLE NITROGEN IN RURAL ECOSYSTEMS: SOURCES AND FATE

Wisconsin University
D. R. Keeney, and L. M. Walsh
Hortscience, Vol. 7, No, 3, p. 219-223, June 1972. 4 fig. 4 tab, 37 ref.

Descriptors: *Nitrogen, *Ecosystems, *Sources, *Water pollution, *Groundwater pollution, *Farm wastes, Agriculture, Fertilizers, Leaching, Crops

This paper is concerned with the sources of nitrate and other nitrogen compounds in surface and groundwater. The most critical problem associated with nitrogen compounds is the possible adverse effect on animals and humans. Potential sources include precipitation, decomposition of crop residues and soil organic matter, legumes, manure, and nitrogen fertilizer. The nitrogen cycle is explained, and a schematic diagram of the cycle is given. Non-agricultural sources of nitrogen include commercial wastes, domestic wastes, urban runoff, industrial wastes, runoff from non-agricultural land, wetlands, geologic sources, lake and river sediments, and nitrogen fixation in waters. Movement of ground water accounts for 2 to 3 times more nitrogen than surface runoff. The amount of leaching at a particular location is largely related to conditions affecting evapotranspiration, soil physical conditions, and to precipitation distribution and intensity. Efficient crop production requires continued and perhaps even increased use of nitrogen fertilizer, but fertilizer and manure must be added in such a way to keep environment pollution to a minimum. Practices recommended for reduction of runoff losses include: use of crop residues; slopes, and fertilization to stimulate early growth of crops. Control of the rate of pollution of underground water can be exercised by methods explained. (Solid Waste Information Retrieval System)

### 1436-B2, D3, F1
### ELECTRICAL METHODS OF TREATING FARM EFFLUENT SHOULD CUT COSTS

Electrical Review, Vol. 187, p. 91, July 17, 1970. 1 fig.

**Descriptors:** *Waste treatment, *Effluent, *Costs, *Farm wastes, Livestock, Equipment, Aeration, Oxidation lagoons, Stabilization
**Identifiers:** *Electrical methods, Electrolytic flotation.

Three electrical methods of low-cost effluent treatment were shown by the Electricity Council at last week's Royal Agricultural Show at Stoneleigh (Warwicks). The first method demonstrated showed how effluent from a herd of 90 to 100 cows, amounting to 150 to 200 gal/day, could be dealt with by spray aeration in a two-section stabilization pond, with one section deeper than the other. Settled liquor is drawn from this deep section by a centrifugal pump and sprayed over the shallow section to aerate it. The overflow passes back over a weir into the deeper section. Total installation cost is estimated at $100 to $200. The second method is for treating pig effluent in an oxidation ditch. This process requires less land for disposal of the residue than would be required for untreated effluent and avoids smell. Manure fed into the ditch is continually aerated by an electric surface rotor consisting of an inverted cone with specially shaped paddles fixed to its underside. The third method is suitable for the removal of finely divided solids and has been tried at Capenhurst on paint as well as pig effluent. Charged hydrogen and oxygen gas bubbles rising from two closely spaced electrodes near the bottom of the treatment tank attract suspended particles and carry them to the surface. The floating sludge layer formed can be removed mechanically. (Solid Wastes Information Rerieval System)

### 1437-A11, B2, C2, D3, E3

### NUTRITIVE VALUE OF AEROBICALLY OR ANAEROBICALLY PROCESSED SWINE WASTE

Illinois University
Urbana
B. G. Harmon, D. L. Day, D. H. Baker, and A. H. Jensen.
Journal of Animal Science, Vol. 37, No. 2, p. 510-513, August, 1973. 6 tab, 17 ref.

**Descriptors:** *Nutrients, *Oxidation lagoons, *Farm wastes, *Hogs, *Feeds, *Recycling, Proteins, Aerobic treatment, Digestion, Anaerobic conditions, Performance, Diets
**Identifiers:** Rats, Residue, Oxidation ditch mixed liquor

The studies presented in this investigation were conducted to define nutritive value of waste processed by aerobic and anaerobic methods. An oxidation ditch was used which provided a means of collecting swine waste and an environment for biologically enhancing the waste to single-cell protein. Attempts to concentrate solids by allowing a fraction of the ditch contents to circulate through a settling-skimming tank yielded a product low in protein. The oxidation ditch mixed liquor serving as a nutrient solution combined with dry feed significantly improved weight gain and feed efficiency of finishing swine fed a dry diet that was marginal in protein. The nutrient solution containing 3 percent dry matter increased protein intake 2.5 percent, and lysine intake by 0.1 percent. It was found that addition of nutrient solution to corn alone did not significantly increase gain or efficiency. (Solid Waste Information Retrieval System)

### 1438-A2,A3,A10,B3,C3,D3,E2

### MANURE STACK FLY BREEDING DEPENDS ON THE AMOUNT OF MANURE ADDED DAILY

W. L. Gajmerac
Hoard's Dairyman, Vol. 117, No. 12 p. 747, June 25, 1972. 1 fig.

**Descriptors:** *Breeding, *Farm wastes, *Waste disposal, *Waste storage, *Dairy industry, Agricultural runoff
**Identifiers:** *Manure stack, *Flies.

Recent work on a 40 head Wisconsin dairy farm showed that the daily summer addition of all manure from a dairy herd will cause an increase in housefly population. To help control fly population, it is suggested that the dairymen stack all the manure during the winter and spring, hold the stacked manure until fall, then spread it and plow it under immediately. This lets the dairymen haul the manure in the fall when they have more free time and it cuts down on polluted runoff into waterways It is believed that beneficial insects and mites inhabit the old stacks and eat the fly eggs and maggots. If only small amounts of manure are added daily during the fly breeding season these beneficial insects manage to keep fly population low. However, if large amounts of fresh manure are added daily, these insects cannot keep up with the fly reproduction. It is suggested that local health officials be contacted concerning their opinion toward flies before new manure handling facilities are developed. (Lee-East Central)

### 1439-A10, B2, B4, E2

### EVERYTHING IS ON SLATS

L. Elam
Hoard's Dairyman, Vol. 117, No. 12, p. 745, June 25, 1972. 3 fig.

**Descriptors:** *Farm wastes, *Dairy industry, *Feed lots, *Waste disposal, Irrigation
**Identifiers:** *Slats, *Slatted floors

Charles Ochsner, of Sumner, Washington, has utilized an easy and inexpensive system of manure handling on his dairy through the use of slatted floors. This system cut one man off the payroll and virtually eliminated flies. The milking parlor, calf barn, feeding barn and free stall barn are arranged in a square with a 95,000-gallon concrete liquid manure tank in the center of the open square area, framed by the buildings. The free stall barn and feeding barn have slatted floors directly over pits in which sufficient water is kept to make the manure into solution. Each pit has sliding gates which when lifted allow the material to flow to the main pit by gravity. The gates are then closed and necessary water is put into the pit. The corral area over the main pit is all concrete floored. There is also a large concrete watering trough, and an agitator and pumping system over the center of the pit. Gratings which can be lifted out for inspection are located over drainways leading to the main pit so manure can be scraped in. It takes about a half hour daily to clean the corral with a shovel. The corral and slats are never washed down. Water and manure from the holding corral and milking barn flow into the pit through pipes. The liquid manure in the large pit is pumped through 4 inch lines to 115 acres of pasture and is spread by a large sprinkler. The pump, which is also used for agitation, is powered by a 70 horsepower diesel engine. (Lee-East Central)

### 1440-A4,A6,A7,B1,B4,B5,C2, D3,E2

### FEEDLOT ODOR

Regional Extension Specialist
Feedlot Waste Management
M. D. Paine
Great Plains Beef Cattle Feeding Handbook. Cooperative Extension Service — Great Plains States, GPE-7800, L-1101, November, 1972, p. 7800.1—7800.2.

**Descriptors:** Feed lots, *Odor, *Aerobic conditions, *Anaerobic conditions, *Waste treatment, *Ammonia, Biological oxygen demand, Nutrients, Metabolism, Nitrogen, Aeration, Waste disposal.

Feedlot odor is caused by the anaerobic metabolism of nutrients found in cattle manure. However, when the nutrients are metabolized aerobically the end products are heat, CO2, and water. For aerobic metabolism to occur, the oxygen transfer rate must exceed the biological oxygen demand. When the demand is greater than the transfer rate, anaerobic metabolism produces odor compounds. Ammonia is also produced in feedlots. It is lighter than air and has an irritating smell. It escapes as a gas from urine, but will be absorbed by moist manure. The transfer of nitrogen in ammonia and amines not only produces irritating smells, but may enrich ponds, hastening eutrophication. Odor occurs in three places—the dry surface, solid manure beneath the surface, and holding ponds. Aerobic metabolism depends on temperature, oxygen, and water; the last two may possibly be controlled. Moisture can be partially controlled by good drainage, cattle density and water. Since a 40% moisture content is required for best aerobic activity, sprinkling may be required in dry seasons, Odor from ponds may be controlled by diluting nutrients, adding more water, or using aeration equipment. Manure may be stockpiled into compost heaps prior to being dispersed on farm land. (Lee-East Central)

### 1441-A11, B1, F6

### SOLID STATE CONTROLS FOR ENVIRONMENTAL CHAMBERS

Department of Agricultural Engineering
Arkansas University
Fayetteville
T. R. Rokeby, G. S. Nelson, and G. C. Harris, Jr.
Presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-418, 11 p. 9 fig.

**Descriptors:** *Poultry, *Performance, *Environmental control, Temperature, Air circulation, Growth rates
**Identifiers:** *Solid state controls, *Environmental chambers, Drinking water, Feed conversion

Research was done to regulate temperature, air flow and drinking water temperature in order to examine the effects on poultry performance. Chamber design criteria included the following. Dry bulb temperature ranged from 35°F to 105°F. Wet bulb temperature ranged from 35°F to 95°F. Air movement didn't exceed 300 fpm at the floor level. Air exchange was fixed at 300 cfm. Chamber size was 8' by 12' by 7'. Chamber ambient conditions were 80°F maximum dry-bulb, Temperatures ranged from 69°F maximum wetbulb summer to 70°F dry bulb in the winter. Drinking water temperature was controlled. Different initial brooding temperatures, different rates of temperature decline with age, and different water temperatures were investigated. Analysis of results was incomplete but indicated that growth and feed conversion were best with initial brooding temperatures of 89°F (32°C), and that cooling the drinking water could aid the chicken to adapt to higher ambient temperatures. (Lee-East Central)

### 1442-A11, B1, F6

### OPERATIONAL CHARACTERISTICS OF MEAT ANIMALS

Department of Agricultural Engineering
Nebraska University
Lincoln
N. C. Teter, J. A. DeShazer, and T. L. Thompson

**Descriptors:** *Metabolism, *Performance, *Mathematical models, Temperature, Feeds, Mud, Energy loss, Environment
**Identifiers:** *Operational characteristics, *Beef, Energy intake

Basic data published on the energetics of beef animals combined with the basic theory of metabolic changes in beef animals were used to develop a model to predict characteristics and production of growing beef as a function of effective temperature, feed, and mud conditions. In cold weather much of the animal's energy is used to maintain body heat so more feed is required per pound of gain. The heat value of the feed, calculated in BTU's, determines how much feed will be needed for each pound of gain. Mud conditions are important, for an animal must expend high amounts of energy to move in mud that could otherwise be converted into meat. (Lee-East Central)

## 1443-A2, A3, A4, A11, A12, B1, C2, C3, E2

### SURFACE WATER QUALITY IS INFLUENCED BY AGRICULTURAL PRACTICES

Minnesota University
Morris
R. F. Holt
Transactions of the American Society of Agricultural Engineers, Vol. 16, No. 3, p. 565-568, 1973, 3 tab, 34 ref.

Descriptors: *Surface waters, *Water quality, *Water pollution, Fertilizers, Farm wastes, Pesticides, Agricultural runoff, Phosphorus, Nitrogen, Soil conservation, Waste disposal.
Identifiers: *Agricultural practices, Leptospirosis, Fish kills

The effects of fertilizer runoffs, pesticides, and feed lot wastes on surface water quality are discussed in this paper. The three constituents of animal waste that pose a threat to water quality are BOD, infectious agents, and dissolved chemicals, which are primarily nutrients. Rapid influxes of animal waste into waterways can cause massive fish kills, due to reduced oxygen levels; constant, but less rapid, contamination will simply drive the fish away, killing only less mobile forms. Maximum textured, well drained soil can degrade 250 to 300 lb of BOD per acre per day. The soil also quickly destroys pathogens, such as streptococcus, anthrax, hog cholera, and mastitis. Although few of these diseases infect man, all can be transmitted to other animals. Plant nutrients, most frequently nitrogen and phosphorus, allowed to run off into streams, either directly from the feed lot or indirectly after application to frozen or saturated soils, are also detrimental to water quality. If manure is disced in as soon as applied, runoff of nutrients is avoided. (Solid Waste Information Retrieval System)

## 1444-A5, A8, C2, E2

### EFFECT OF FEEDLOT MANURE ON SOIL AND WATER QUALITY

Research Station
Lethbridge, Alberta T1J 4B1
Canada Department of Agriculture
T. G. Sommerfeldt, U. J. Pittman, and R. A. Milne
Journal of Environmental Quality, Vol. 2, No. 4, p. 423-427, October-December, 1973, 3 fig, 4 tab, 19 ref.

Descriptors: *Feed lots, *Farm wastes, *Soil contamination, *Water pollution, *Groundwater pollution, Nitrogen, Phosphorus, Effluent, Fertilizers, Waste disposal, Cattle
Identifiers: *Soluble salts, *Manure

A study of soil pollution and ground water pollution caused by feedlot manure was undertaken in southern Alberta. The study also investigated long term effects of manure applications on the nitrogen, phosphorus, and soluble salt content of cultivated soil under irrigation. It was found that nitrate and phosphorus content of surface soil was higher in soil adjacent to feedlots than in soil away from them. However, at depths greater than 150 cm, the differences were insignificant. This was also found to be true in ground water at depths of 1-5 meters. No evidence was found which indicated that nearby streams or lakes were polluted by feedlot effluent. Long term effect studies indicated that 40 annual applications of manure did not elevate nitrogen, phosphorus or soluble salt contents of the soil significantly. The unique combination of soil, climate, and management in southern Alberta has been an important factor in limiting soil and water pollution from manure. (Russell-East Central)

## 1445-B2, D1

### DESIGNING GUTTER FLUSHING SYSTEMS FOR SWINE

Agricultural Engineering Department
Missouri University
Columbia
R. M. George, and C. E. Browning
Presented at the 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, 11 p. 2 fig. 5 tab, 3 ref.

Descriptors: *Design, *Hogs, *Farm wastes, *Waste treatment, *Waste disposal, *Lagoons, Effluent, Flow, Width, Depth
Identifiers: *Gutter flushing systems, *Swine, Slope

Design procedures are given for designing open gutter and under slat gutter systems for swine. Gutters should be one half as wide at the exit as they are at the origin and should be wide enough to induce hogs to utilize them. Amounts of water needed vary with depth of manure; width, depth, length, and roughness of the gutter; and the velocity of the water needed to flush the system. (Lee-East Central)

## 1446-A2, A4, A5, C2

### A STUDY OF FACTORS INFLUENCING THE NITROGEN AND PHOSPHORUS CONTENTS OF NEBRASKA WATERS

Nebraska University
Lincoln
J. Muir, E. C. Seim, and R. A. Olson.
Journal of Environmental Quality, Vol. 2, No. 4, p. 466-470, October-December, 1973. 1 fig, 5 tab, 14 ref.

Descriptors: *Nitrogen, *Phosphorus, *Water pollution, *Groundwater pollution, *Nebraska, Irrigation, Agricultural runoff, Fertilizers, Nutrients, Sampling, Streamflow

Research was conducted to determine amounts and sources of nutrients and phosphorus in Nebraska waters. Results indicate that the quality of Nebraska waters is not being materially influenced by agricultural use of commercial fertilizers. Exceptions exist when fertilizer nitrogen contributes to ground water nitrates. This occurs when there is intensive irrigation of sandy soil and with irrigated crop production in valley positions of shallow underlying water tables. It was found that nutrient levels in the water are governed more by livestock and human densities than by any other factor. The high nitrogen content of streams during peak flow can be attributed partially to direct runoff into streams resulting from high rainfall intensity. (Russell-East Central)

## 1447-A2, A5, C2, E1

### SEEPAGE OF FEEDYARD RUNOFF WATER IMPOUNDED IN PLAYAS

USDA Southwestern Great Plains Research Center
Bushland, Texas
O. R. Lehman, B. A. Stewart, and A. C. Mathers

Descriptors: *Agricultural runoff, *Seepage, *Playas, *Feed lots, *Impoundments, Farm wastes, Aquifer, Nitrates, Chlorides, Soil water, Sampling
Identifiers: Ammonium

Research was conducted in a playa at Randall County Feedyards Inc., 10 miles, S.W. of Amarillo, Texas, to determine if pollutants from feedyard runoff water seep through playa soil and contaminate groundwater. In August, 1968, a large amount of runoff was impounded in the playa. In March, 1969, soil samples were taken at various sites across the playa at depths from 1 to 13 feet. A second playa 3 miles North was used as a representative before impoundment of feedyard runoff. Soil samples were analyzed for nitrite, nitrate, ammonium, chloride, and water content. Concentrations of nitrite, nitrate, ammonium and chloride were found to decrease steadily with depth. The percentage of soil moisture also decreased with depth. Findings suggest that little or no pollutants will seep through the bottom of playas with fine soil texture. The hazard of groundwater pollution may be greatest in smaller deeper playas with sloping, coarse soils immediately surrounding the playa bottom. (Lee-East Central)

## 1448-A8,A11,A12,B2,C3,E2

### THE INFLUENCE OF MANURE SLURRY IRRIGATION ON THE SURVIVAL OF FECAL ORGANISMS IN SCRANTON FINE SAND

Department of Microbiology
Florida University
Gainesville
F. Dazzo, P. Smith, and D. Hubbell
Journal of Environmental Quality, Vol. 2, No. 4, p. 470-473, October-December, 1973. 2 fig, 2 tab, 20 ref.

Descriptors: *Sprinkler irrigation, *Farm wastes, *Waste disposal, *Salmonella, *Soil contamination, Pathogenic bacteria, Enteric bacteria, Cattle
Identifiers: *Manure, *Slurries, *Survival, *Fecal organisms, *Scranton fine sand, Fecal coliforms, Health hazard

This study was undertaken to examine the effects of various rates of irrigation of cow manure slurry on the survival of Salmonella enteritides serotype Enteritidis and fecal coliforms within scranton fine sand. Millet was inoculated with O, 1.27, 2.54, and 5.08 cm of the cow manure slurry. The numbers of viable enteric organisms were determined at various times after inoculation. It was found the death rate of both groups declined in soil which previously had received manure application. Results indicate several long-term ecological effects of increasing the manure slurry irrigation rates on the receiving soil. The potential danger of health hazards associated with the use of contaminated soil would be expected to increase with increasing rates of application. This study on a pilot scale irrigation system showed that pathogen survival is a problem which should be considered and controlled in the design and operation of a waste treatment process involving sprinkler irrigation on land. (Russell-East Central)

## 1449-A2, A4, C3

### BENTHIC MACROINVERTEBRATE COMMUNITY STRUCTURE IN A GREAT PLAINS STREAM RECEIVING FEEDLOT RUNOFF

Kansas State Teachers College
Emporia
C. W. Prophet, and N. L. Edwards
Water Resources Bulletin, Vol. 9, No. 3, p. 583-589, June, 1973. 4 tab, 8 ref.

Descriptors: Benthic fauna, *Feed lots, *Agricultural runoff, Kansas
Identifiers: *Benthic macroinvertebrate community, *Environmental quality, *Species diversity, *Cottonwood River, Water pollution, Fishkill, Sampling, Environmental stress

Due to the increase and concentration of feedlots, a study was undertaken to determine the effect of feedlot runoff on the ecological balance and environmental quality of the Cottonwood River in Kansas. The effect was evaluated by analysis of community structure of benthic macroinvertebrates using the species diversity index (d). Sixty-five taxa were identified during the study from 1968 to 1971. The species diversity index was lower closer downstream from the feedlots and increased at each station down stream, but at all stations it was lower than at the control station. There was a significant increase in the index after the feedlots were closed. Results indicate that runoff from feedlots had an adverse effect on the environmental quality of the river, and this effect continued long after water quality was restored. However, the recovery was rapid once the environmental stress was removed. (Russell-East Central)

## 1450-A8, B3, E3

### USING POULTRY LITTER, IRRIGATION, AND TALL FESCUE FOR NO-TILL CORN PRODUCTION

United States Department of Agriculture
Athens, Georgia
J. R. Carreker, J. E. Wilkinson, J. E. Box., Jr., R. N. Dawson, E. R. Beaty, et al.
Journal of Environmental Quality, Vol. 2, No. 4, p. 497-500, October-December, 1973. 10 fig. 6 tab, 14 ref,

Descriptors: *Poultry, *Litter, *Irrigation, *Fescues, Crops, Fertilizers, Nitrogen, Phosphorus, Potassium, Lime, Productivity, Farm wastes, Waste disposal, Erosion control, Irrigation, Agricultural runoff
Identifiers: *No-till corn, *Southern Piedmont, *Killed sod, Atrazine, Paraquat, Pollution

This study was undertaken because of the need for a cropping system in the Piedmont area which would increase the production of forage and grain, control erosion, and utilize the available nutrients in poultry litter. The objective was to determine the response of irrigated no-till corn, Zea Mays (L), to applications of poultry litter in tall fescue (Festuca arundinacea Schreb.). Corn was planted and irrigated in live soil and in soil that was killed with 2.2 and 0.28 kg/ha atrazine and paraquat, respectively. Poultry litter was then added to soil plots at different rates. Nitrogen, phosphorus, potassium, and lime were added uniformly to all soils. Corn yields were higher in killed sod than in live sod. The overall increase was 80%. This method gave excellent runoff and erosion control and produced needed [illegible] while utilizing a waste product with minimum environmental hazards and with small amounts of litter application. (Russell-East Central)

## 1451-A1,B1,D1,D2,D3,E1,F4

### PROCEEDINGS: BIG ISLAND SWINE CONFERENCE, CURRENT AND FUTURE TRENDS IN SWINE WASTE MANAGEMENT

Proceedings: Big Island Swine Conference, Current and Future Trends in Swine Waste Management, Miscellaneous Publication 82, Cooperative Extension Service, University of Hawaii, September 11, 1971, 28 p.

Descriptors: *Hogs, *Farm wastes, *Hawaii, *Waste treatment, *Waste storage, *Waste disposal, Confinement pens, Production.
Identifiers: *Pork industry, *Pollution, *Swine, *Waste management, *Trends

This conference was held with the purpose of discussing pork producers' problems and solutions. Planning, budgeting, production, pollution, ecology, waste treatment, waste disposal, and zoning were major topics discussed at this meeting. It was hoped that the conference would be a major step forward in pushing standards for quality, price stabilization, and technological improvement in Hawaii. (Merryman-East Central)

## 1452-A2,A6,B1,B4,D3,E1

### FEDERAL PRODUCER ASSISTANCE PROGRAMS

A. Bennett
Proceedings: Big Island Swine Conference, Current and Future Trends in Swine Waste Management, Miscellaneous Publication 82, Cooperative Extension Service, University of Hawaii, September 11, 1971, p. 5.

Descriptors: *Farm wastes, *Waste treatment, *Cost sharing, Aerobic conditions, Anaerobic Diversion structures, Hawaii
Identifiers: *Federal Producer Assistance

To assist producers in installing adequate treatment facilities for animal wastes, the Agricultural Stabilization and Conservation Service provides payments in the form of cost-share for installation of waste disposal systems. These systems are usually one of three types: Lagoons, Storage facilities, or Diversions. Lagoons treat wastes in such a way that the waste can either be directly discharged to a waste course or on land. There are two types of lagoons—Aerobic, which requires a large land area, and anaerobic, which requires little land area but produces an offensive odor. Storage facilities are used temporarily until waste is removed and spread on land for fertilizer as needed. Diversions are used to divert excess runoff from feedlots or waste disposal areas to treatment locations. In Hawaii, lagoons should be adequate to fill the needs for waste treatment because they can function year round; whereas, on the mainland temperature variations allow them to function only eight to nine months of the year. (Russell-East Central)

## 1453-A12,B2,B4,D3,E1,E2

### BASIC REQUIREMENTS OF HOG PEN CONSTRUCTION AND LIQUID MANURE DISPOSAL

J. Nakahara
Proceedings: Big Island Swine Conference, Current and Future Trends in Swine Waste Management, Miscellaneous Publication 82, Cooperative Extension Service, University of Hawaii, September 11, 1971, p. 6-7.

Descriptors: *Confinement pens, *Construction, *Hogs, *Liquid wastes, *Waste storage, *Waste disposal, *Hawaii, Cesspools, Septic tanks, Lagoons
Identifiers: Manure

Many problems of waste disposal have originated from confinement hog feeding. The first consideration to alleviate these problems is construction of feeding facilities. Floors, feed troughs, and gutters should be constructed so that they are impervious to water and can be properly flushed with water. Loose boards should not be used unless they can be easily removed. Feed bins and pens should be constructed so that they are rodent-proof. Presently, there are four methods of liquid disposal commonly used. Cesspools and septic tanks can be utilized in small operations, but aren't feasible in large ones. Spreading of fertilizer can be used, but a large land area is required. Lagoons can also be constructed but should be in accordance with guidelines laid down by the Department of Health. Adequate manure disposal can be controlled by proper design and maintenance of lagoons. However, in Hawaii, lagoons are often undersized because of the scarcity of land. Regardless of the type of waste disposal used, it must include not only the prevention of health hazards, but also the prevention of aesthetic nuisances. (Russell-East Central)

## 1454-B1, F2

### HOG PRODUCTION ZONING REQUIREMENTS

P. Yoshimura
Proceedings: Big Island Swine Conference, Current and Future Trends in Swine Waste Management, Miscellaneous Publication 82, Cooperative Extension Service, University of Hawaii, September 11, 1971, p. 8-9.

Descriptors: *Hogs, *Zoning, *Hawaii
Identifiers: Piggery, Non-Conforming piggery, Residential agricultural zone, Unplanned zone, Agricultural zone, Planning Commission, Property line, Board of Health

By Hawaiian state law a piggery is any premise on which five or more weaned hogs are maintained. The maintenance of hogs is regulated by zoning requirements and pigs may be allowed in three zones: The RA zone, A zone, and U zone. The RA or Residential Agricultural zone applies to a low density suburban area with a minimum allowable lot of one-half acre. It is subject to the Department of Health and it must be kept at least sixty feet from any property line. The A or Agriculture zone applies to an agricultural area with allowable lot sized from 1-40 acres. It must be 1,000 feet or more from any major public road and accessory buildings shall be at least 100 feet from the front property line. The U or Unplanned zone applies to areas not subject to sufficient studies to adopt specific zones. Lot sizes are a minimum of five acres. Pens cannot be closer than 100 feet from any property line or 50 feet from any residence, and they must be on sites approved by the Board of Health. Variances from these regulations can be granted by the Planning Commission. Also piggeries in existence before zoning may remain as long as they do not enlarge. (Russell-East Central)

## 1455-A6,A10,A12,B1,D3,E2,E3

### SWINE WASTE DISPOSAL AND CONTROL

Department of Animal Sciences
University of Hawaii
Honolulu
Hugh Williams
Proceedings: Big Island Swine Conference, Current and Future Trends in Swine Waste Management, Miscellaneous Publication 82, Cooperative Extension Service, University of Hawaii, September 11, 1971, p. 10-11. 4 ref.

Descriptors: *Hogs, *Waste disposal, *Control, *Confinement pens, *Farm wastes, Aerobic conditions, Anaerobic conditions, Recycling, Livestock, Pollutants, Hawaii
Identifiers: Composting, Land spreading

The Hawaii Department of Health Studied 179 hog operations and found that 94 posed a problem to neighbors due to animal wastes. It is estimated that fifty percent of wastes were from confinement areas, and this poses a particular problem in Hawaii because of scarcity of land. The study found that pollution from animal manures arises because of: organic substances, inorganic substances, odors, infectious agents, and insects. Waste management systems usually incorporate land spreading, biological treatment, composting, or recycling as feed. Land spreading is the major method employed, but it requires a large land area. Biological treatment by means of lagooning is more feasible in Hawaii, and there are two types— aerobic and anaerobic. Anaerobic lagoons produce odors but do not require as much land area as the non-odorous aerobic lagoons. Composting or drying is also effective in that it reduces volume and weight by fifty percent. Recycling as feed could become an effective means of waste utilization, but the Food and Drug Administration looks unfavorably on this method. However, experimental work has incorporated as much as fifty-seven percent manure into cattle rations. (Russell-East Central)

## 1456-B2, D3, E1, E2

### SWINE HOUSING AND WASTE DISPOSAL DESIGNS

University of Hawaii
Honolulu
Donald Nelson
Proceedings: Big Island Swine Conference, Current and Future Trends in Swine Waste Management, Miscellaneous Publication 82, Cooperative Extension Service, University of Hawaii, September 11, 1971, p. 13-23. 5 fig. 7 tab.

Descriptors: *Hogs, *Farm wastes, *Waste disposal, *Design, *Lagoons, *Oxidation lagoons, Aerobic conditions, Anaerobic conditions, Biological treatment, Liquid wastes, Surface runoff, Hawaii
Identifiers: *Swine, Slatted floors

The system chosen for proper waste disposal is very important. It should be adequately designed to handle current and future wastes, and it should comply with all laws. To develop a lagoon system, the floors should be slotted so they can be flushed with water. There should be a gutter beneath the floors which could either store the wastes or carry them to a lagoon or oxidation ditch. The lagoon is either a deep ditch called an anaerobic lagoon or a shallow one called an aerobic lagoon. The liquid of both should be maintained and excess should be spread on land. In oxidation ditches, decomposition is accomplished by aerobic bacteria. These bacteria decompose with virtually no odor. Oxidation ditches can also be used in conjunction with other disposal methods such as lagoons. A problem with lagoons and oxidation ditches is runoff of rainfall. This, however, can usually be controlled by choice of locations. (Russell-East Central)

### 1457-B1, F3

### HAWAII, ISLAND OF HOPE FOR PORK INDUSTRY

State Department of Agriculture
Hawaii
F. Erskine
Proceedings: Big Island Swine Conference, Current and Future Trends in Swine Waste Management, Miscellaneous Publication 82, Cooperative Extension Service, University of Hawaii, September 11, 1971, p. 25-27.

Descriptors: *Hawaii, Hogs, Automation
Identifiers: *Pork industry, Swill collection, Super farm, Agri-business, Tilapia production

The high cost of land in Hawaii has caused the high cost of pork production. This high cost of land paints a dark picture for the pork industry because it doesn't allow the Hawaiian pork producers to compete with the mainland. The ideal way to compete with other pork producers is to have a super farm which is a massive agricultural complex for production of beef, pork, feed, etc., and to have a large combined waste disposal system to eliminate pollution. This super farm could someday be a reality; but, for the present, pork producers must organize to improve the pork industry by: finding capital, planning and developing for the industry's future, establishing more efficient programs such as swill collection and processing, establishing standards of quality and price stabilization, developing and supporting marketing programs, pushing technological research, and improving the aesthetics of the hog farm through landscaping and odor reduction. (Russell-East Central)

### 1458-B1, F3

### CURRENT PROBLEM FACING THE PORK PRODUCERS — SOME OBSERVATIONS

S. Roehrig
Proceedings: Big Island Swine Conference, Current and Future Trends in Swine Waste Management, Miscellaneous Publication, 82, Cooperative Extension Service, University of Hawaii, September 11, 1971, p. 28.

Descriptors: Hogs, *Production, Processing, Hawaii
Identifiers: *Pork industry, *Slaughtering

It appears that Big Island pork producers face a promising future. The chief way to insure this future is to work together and have periodic meetings to consider problems of the industry—problems such as disease, production, ecology, etc. It is also important that price standards and uniform consumption policy be adopted. Local pork producers should collectively promote consumption of pork in the Islands. Yet, the producers must face the problem of slaughtering. Since there is only one slaughter house on Oahu, the producers themselves should construct and maintain a slaughter house. By doing this, they coulld have some control over the disposition of the carcasses. With a joint effort of the government and the pork producers, the Hawaiian pork industry should prosper in the future. (Russell-East Central)

### 1459-B1, F1

### SUMMARY AND CONCLUSION

County Extension Service
Hawaii
T. T. Yamamoto
Proceedings: Big Island Swine Conference, Current and Future Trends in Swine Waste Management, Miscellaneous Publication 82, Cooperative Extension Service, University of Hawaii, September 11, 1971, p. 29.

Descriptors: *Hogs, Confinement pens, Pollutants, Ecology, Hawaii
Identifiers: *Pork production, *Waste management

The theme of the Conference was: "Current and Future Trends in Swine Waste Management." It was "A step in the right direction" as far as the efficiency of the pork industry of Hawaii is concerned. Pork producers must become more aware than ever of pollution, ecology, and environment if the industry is to grow and fulfill the state pork needs. There are now sixty sows on three-fourths acres of land as compared with twenty sows on four acres of pasture land in the past before confinement was adopted. This kind of change brings many problems which must be faced. In closing, early planning of a waste disposal system is vital for future expansion and productivity. (Russell-East Central)

### 1460-A1, B1, F2

### AN IN-DEPTH LOOK AT FEDERAL POLLUTION CONTROLS

Wisconsin University
Madison
R. E. Graves
Hoard's Dairyman, Vol. 119, No, 9, p. 614, 653. 1 fig.

Descriptors: *Regulation, *Environmental control, *Feed lots, *Livestock, *Poultry, Agricultural runoff, Permits, Waste treatment, Waste disposal, Federal Water Pollution Control Act
Identifiers: *Federal pollution controls, *Zero discharge, Environmental Protection Agency

New EPA guidelines for feedlots were published in February and were met with tremendous reaction. One reason for the strong reaction was that they seemed to include livestock under every conceivable system of management. No distinction was made based on numbers of animals, concentration of animals, or location with respect to streams or lakes. EPA considers any confined group of beef, dairy cattle, swine, sheep, horses, chickens, turkeys, or ducks a potential feedlot. The most drastic change found in the guidelines and standards recently issued was the exclusion of smaller livestock farms. Exclusion from these regulations does not mean that smaller livestock farms can forget about pollution control. Any person or firm is still responsible for water pollution resulting from its actions or inactions. The most outstanding conclusion and recommendation of this report deals with "zero discharge." Without establishing a meaningful definition of zero discharge or even feedlot pollution, it was concluded that practicable available technology is available to achieve zero discharge from all feedlots by July 1, 1977. (Cartmell-East Central)

### 1461-A4, B1

### QUALITATIVE CHANGES IN THE FISH-FAUNA OF THE UPPER NEOSHO RIVER SYSTEM, 1952-1967

F. B. Cross, and M. Braasch
Transactions of the Kansas Academy of Science, Vol.71, No. 3, p. 350-360, January 7, 1969. 1 fig, 1 tab, 6 ref.

Descriptors: *Fish, *Water pollution, *Feed lots, *Farm wastes, Kansas
Identifiers: *Upper Neosho River, Fish fauna, *Fish kills

A comparison obtained from extensive collections from the Upper Neosho River System in Kansas was made between species of fish collected in 1952 and 1967. The study indicated rapid deterioration of the fish fauna. Numerous fish kills were noted to occur in 1966 and 1967 and were attributed to pollution from feedlots whose wastes drained into nearby streams. Five species of fish collected in 1952 were not found in 1967. Other species are in danger of disappearing while some 20 species have declined in abundance during the 15-year period. Fish which predominated in 1967 were kinds whose surface-dwelling habits enhance their tolerance of waste pollution. It is hoped that laws passed in 1967 will be strictly enforced. If pollution is curbed, perhaps the number of fish kills will be reduced. (Russell-East Central)

### 1462-B1, E2, E3

### COPROLOGY: A POLLUTION SOLUTION?

Ohio State University
Columbus
E. P. Taiganides
Agricultural Engineering, Vol. 55, No, 4, p. 21, April, 1974, 1 fig.

Descriptors: *Recycling, *Farm wastes, Sewage, Municipal wastes, Pollutants, Foods, Ecology, Methane, Gases
Identifiers: *Coprology, *Pollution, *Waste management, Building blocks

Coprology is defined as the science of waste management. The basic premise of coprology is that there is no such thing as waste. Everything is a resource. Research is being conducted to find new ways of recycling wastes. It is estimated that livestock wastes in the United States could be used to produce methane gas in sufficient quantities annually to meet a large part of our national gas requirements. The potential value: of manure-derived methane gas is over one billion dollars. Also, city waste refuse is being made into building blocks or into heat energy. City sewage is being used to increase productivity of land. In the future, the need for more food will drastically increase. With this increase will be a matched increase in waste production. The problems of waste management must be dealt with and controlled and future industrialization must not only be justified on economic and political terms, but also on ecological terms. (Russell-East Central)

### 1463-A6, A8, B2, D1, D3, E2, F1

### MECHANICAL AERATION OF A WASTE DISPOSAL MANURE PIT

Area Agricultural Engineering Specialist, Higginsville, Missouri
L. V. Ellis, and R. M. George
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, 6 p. 2 fig, 4 ref,

Descriptors: *Aeration, *Waste treatment, *Waste disposal, Mechanical equipment, Liquid wastes, Odor, Costs, Waste storage
Identifiers: *Milking machine compressor

A swine producer in Johnson County, Missouri uses a milking machine compressor unit to bubble air through liquid manure holding pits. Complete design for the system is given in detail. The final results of this experiment are not all known at this time, but the producer wants to continue with this system of aerating his manure pits. He feels the offensive odors have been greatly reduced in the pits, his building, and from the effluent when it is spread on his fields. The solids in the pits are broken up and held in suspension. The manure that was spread on the fields gave good response in the form of plant growth. Operating costs are small; electricity costs about 3c an hour. If the unit operates for 16 hours in 24 hours, the cost is about 48c per day. (Cartmell-East Central)

### 1464-A11, B5

### FRACTIONATION OF A CHICK GROWTH DEPRESSING FACTOR FROM RYE

Department of Animal Science
Washington State University
Pullman
R. Fernandez, E. Lucas, and J. McGinnis
Poultry Science, Vol. 52, No. 6, p. 2252-2259, November 1973. 5 tab, 16 ref.

Descriptors: *Poultry, *Diets, *Growth rates, *Farm wastes, Ethers, Swine, Feeds, Performance, Water
Identifiers: Fractionation, *Growth depressing factor, *Rye, Acetone, Extract

Four experiments were conducted to study the nature of chick growth depressing factor or factors present in rye. Chicks were fed acetone extracted rye, Day-old chicks were used in all experiments. Results obtained in Experiment 1 showed clearly that the acetone extraction of rye did not remove the chick growth depressing factor present in rye. The results of Experiments 2, 3, and 4 consistently indicated that the fraction of rye that contains most of its chick growth depressing properties and also contains the factor causing sticky droppings associated with feeding rye to young birds can be removed by a simple water extraction. Experiment 2 gave a clear indication that feces stickiness by itself was not deleterious to chick growth and that this effect was caused by a factor that was different from the one that causes growth depression. (Cartmell-East Central)

### 1465-F4, F6

### NATIONAL ANIMAL FEEDLOT WASTES RESEARCH PROGRAM

Environmental Protection Agency
Robert S. Kerr Environmental Research Laboratory
Ada, Oklahoma
L. R. Shuyler
Environmental Protection Agency Report, EPA-R2-73-157, February 1973.

Descriptors: *Feedlots, *Animals, *Wastes, Water quality control, Pollution abatement, Planning
Identifiers: *National research program, *Animal feedlot wastes, Agricultural waste water

The status of the National Animal Feedlot Wastes Research Program is presented. Current research projects and future program development are discussed. Research and investigations are needed to evaluate the effectiveness of potential treatment and control measures. Examples of such projects are presented. Demonstrations and educational activities will be required to provide widespread acceptance of new concepts. The future plans of the program are presented on a PERT diagram. The time frame for the PERT diagram is dependent on funding and may be adjusted slightly in the future.

### 1466-A1, A9, E3

### AGRICULTURAL WASTES AND THE ENVIRONMENT

Agricultural Engineering Department
Ohio State University
Columbus
E. P. Taiganides
Agricultural Engineering, Vol. 51, No. 6, p. 358-359, June, 1970.

Descriptors: *Farm wastes, Water pollution sources, Effects, Irrigation effects, Insecticides, Nitrates

Agricultural wastes contribute fifty percent of the sediment load in rivers in the United States. Animal wastes, crop residues, in addition to insecticides, fertilizers, waste waters from agrochemical processing plants make up these polluting agricultural wastes. The author contends that 'recycling these wastes into the production system' is the only effective way to manage these wastes. (Holmes-Rutgers)

### 1467-A9, A10, C3

### CONTROL OF LARVAE OF THE HOUSEFLY AND THE HORN FLY IN MANURE OF INSECTICIDE-FED CATTLE

Entomology Research Division
Agricultural Research Service
USDA, Kerrville, Texas
R. O. Drummond, T. M. Whetstone, and S. E. Ernst
Journal of Economic Entomology, Vol. 60, No. 5, p. 1306-1308, October, 1967. 2 tab, 13 ref.

Descriptors: *Farm wastes, *Insecticides, *Cattle, *Control, *Larvae, Sampling
Identifiers: *Flies

Short term feeding experiments were conducted to see if certain insecticides fed to cattle could be effective in controlling the common house fly Musica Domestica L. and the horn fly Hematobia irritans L. Fly larva was implanted in the manure of insecticide-fed cattle, and the number of adults that emerged were calculated in determining the effects of the treatments. Mg per kg per day of insecticide effective against house fly larvae were: 5.0 of Bay 37342, 10.0 of bromophos and SD-8447. Mg per kg per day of insecticide effective against horn fly larvae were: 0.5 of Bay 37341, 1.0 of Bay 37340, 10.0 of bromophos, 2.5-5.0 of famphur, 0.5-1.0 of fenthion, 1.5 of Imidan, 10.0 of Shell SD-8447, and 2.5 of Stauffer R-3828, Perhaps in the future insecticides can be combined with a polymer to prevent them from being absorbed in the gastro-intestinal tract and feed incorporation of insecticides can become a common method of fly control. (Russell-East Central)

### 1468-C1, D1, D2, E3, F1

### DEHYDRATION OF ANIMAL WASTES FROM LIVESTOCK MARKETS

Columbia ARS Research Station
North Central Region
H. F. Mayes, and T. F. Webb
Agricultural Research Service Report, ARS-NC-9, 6 p., December, 1973, 3 fig, 1 tab, 4 ref.

Descriptors: *Dehydration, *Farm wastes, *Waste treatment, *Recycling, Livestock, Odor, *Dusts, Waste disposal, Moisture content, Drying, Fertilizers, Costs
Identifiers: *Animal wastes

Dehydration is a usable method of disposing of large quantities of cattle manure and bedding on livestock markets. The four plants covered in this study used converted alfalfa dehydrators as rotary dryers. All of the rotary drums contained internal flighting, which was an integral part of the outer wall of the drum. Materials processed through dehydrators consisted of cattle manure and bedding. The heat for drying was supplied by natural gas which was burned either in one large nozzle or from several small nozzles. All of the dehydrators studied had a relatively large electrical power demand. Material taken from the conveyor ranged from 37.7 to 64.5 percent. Extremely important is the moisture content of the dried material leaving the rotary drum, and it is difficult to control. Operating problems are discussed in detail. The operating cost of a dehydrating plant consist of labor, fuel, electricity, repairs, and miscellaneous costs. The total operating cost for producing a pound of dried product ranged from 1.6 to 2.2 cents. Dehydrating plants sell the dried product as a specialty fertilizer. (Cartmell-East Central)

### 1469-A7, A11, B1, C3

### COLIFORM BACTERIA IN CHICKEN BROILER HOUSE DUST AND THEIR POSSIBLE RELATIONSHIP TO COLI-SEPTICEMIA

Western College of Veterinary Medicine
Saskatchewan University
Saskatoon, Canada
H. C. Carlson, and G. R. Whenham
Avian Diseases, Vol. 12, p. 297-302, 1968. 1 fig. 15 ref.

Descriptors: *Coliforms, *Bacteria, *Poultry, *Dusts, Stress, Mortality, Humidity, Filters
Identifiers: *Chickens, *Broiler house, *Coli- septicemia, *Air sampling

This project was initiated to determine any relationship between increasing levels of visible dust in the broiler houses, any increase in total bacteria and coliform counts, and the coli-septicemia condition which appeared in the flocks. Six broiler houses were selected for the air sampling and humidity studies. Four of these were large dirt-floor houses holding approximately 11,000 birds each, while two were small houses with concrete floors capable of holding 5,500 birds. The coliform count began at 0 and then rose steeply, reaching a maximum of approximately 33 organisms per cubic foot of air between 2½ and 3 weeks. The level then dropped sharply to 8 organisms per cubic foot at approximately 6 weeks, when it again began to rise, reaching 30 organisms per cubic foot at nine weeks. The total count began at 0 and rose until about 6 weeks, at which point there was an average of 360,000 organisms per cubic foot. Then it dropped and leveled off at 9 weeks at approximately 200,000 organisms. Various factors (such as vaccination, chilling, overheating, crowding, deficient ventilation, rapid growth, change of feed, and inclement weather) have been suggested as stress factors which could complicate an E. coli infection. (Cartmell-East Central)

### 1470-B1, E1, F4

### SWINE HANDBOOK HOUSING AND EQUIPMENT

Midwest Plan Service, Swine Housing Subcommittee
Midwest Plan Service, Iowa State University, Ames, Iowa, 1972, 84 p. 130 fig.

Descriptors: *Hogs, *Equipment, Buildings, Ventilation, Waste disposal, Waste treatment, Waste storage, Materials, Feed lots, Confinement pens
Identifiers: Housing, Fencing, Feeding, Fasteners

This handbook summarizes what agricultural engineering can offer swine producers. It deals with the design and operation of the buildings and equipment necessary for a profitable swine business. The following are discussed in detail: production alternatives; building selection; ventilation; waste disposal; fencing; handling equipment; feeding, materials; and fasteners. Construction diagrams are included. (Cartmell-East Central)

### 1471-A9, A10, B1, D2

### CONTROL OF FLIES AROUND FEEDLOTS

Texas Area Extension Entomologist
B. C. Clymer
Texas A&M University, Texas Agricultural Extension Service, College Station, Great Plains Feeding Handbook, L-1100, p. 7802.1-7802.2, March, 1973.

Descriptors: *Feed lots, *Farm wastes, *Larvicides, *Chemcontrol, *Insecticides, Drainage, Sprinkling
Identifiers: *Flies, *Fly control, *Waste management

Control of common houseflies around feedlots presents feeders quite a problem. Effective housefly control requires proper animal waste management and good feedlot sanitation. Feedlots should be designed to allow proper drainage areas and prevent areas of waste accumulation. The best means of control is prevention of fly breeding areas. Pen drainage should be such that "wet spots" are avoided. Manure and spilled feed should be removed from fly breeding areas. Chemical control should be used in conjunction with proper waste management techniques and not as the sole means of control, Larvicides should be applied to areas of intense larval development, whereas residual and space sprays should be used to control adult flies. If sprinkling is used to relieve cattle heat stress or to control dust, efforts should be made to make sure sprinkler heads do not leak. The control and prevention of flies is not an easy problem to overcome, but good management of pen areas and of waste control go a long way toward alleviating the problem. ((Russell-East Central)

### 1472-A11, B5

### INFLUENCE OF LEVEL OF DEHYDRATED COASTAL BERMUDAGRASS OR RICE STRAW ON DIGESTIBILITY

Louisiana Agricultural Experiment Station
Crowley
T. W. White, F. G. Hembry, and W. L. Reynolds
Journal of Animal Science, Vol. 38, No. 4, p. 844-849, April, 1974. 1 fig, 4 tab, 17 ref.

Descriptors: *Bermudagrass, Cattle, Energy, Feeds, Farm wastes, Drying, Sampling, Chemical analysis
Identifiers: *Dehydrated coastal bermudagrass, *Rice straw, *Digestibility, Roughage

Digestion trials were conducted on steers with rations that contained various levels of dehydrated Coastal bermudagrass or rice straw. The objective of these studies was to determine the influence of roughage level on total ration digestibility. The rations contained 0, 20, 40, 60, 80, or 100% bermudagass in trial 1 and rice straw pellets in trial 2. As the level of Coastal bermudagrass increased there was a linear decrease in energy, dry matter, organic matter, nitrogen-free extract, and ether extract digestibility. With increase in rice straw, a linear and quadratic decrease was observed in the digestibility of all nutrients except crude fiber and ether extract. As the rice straw level increased, crude fiber digestibility increased with linear, quadratic and cubic effects significant. Ether extract digestibility was not influenced by level of rice straw. The type of roughage did not appear to influence energy digestibility at the 20% level but as the level increased the decrease in digestibility was more rapid for rice straw. (Cartmell-East Central)

### 1473-A11, C2, E3

### DIGESTIBILITY OF FEEDLOT WASTE

Oklahoma Agricultural Experiment Station
R. R. Johnson
Animal Science Research, p. 62-65, 1972. 5 tab.

Descriptors: *Feed lots, *Farm wastes, *Recycling, *Feeds, Cattle, Sheep, Ruminants, Proteins, Organic matter, Oklahoma
Identifiers: *Digestibility, Dry matter, Nutritive value

An experiment was initiated to investigate the nutritive value of feedlot wastes as a component of rations for ruminant animals. Three samples of feedlot wastes were obtained from typical feedlot operations. The first was a sample from the mound of material, the second from feedlot waste from a growing lot and the third from a finishing lot. The feedlot wastes utilized in these experiments were extremely high in ash content varying from 35 to 43.5 percent. The crude protein content varied from 15-19 percent. Digestibility of the dry matter varied from 35 to 50 percent and the organic matter, from 42 to 56 percent. The digestible protein content of the feedlot wastes was quite high. Further analyses are being made on these rations and the feces from the animals in the digestion trial to determine the true digestibility of the energy in the ration to confirm the results given. (Cartmell-East Central)

### 1474-C1, C2, D3

### DOUGLAS FIR BARK AS A TRICKLING FILTER MEDIUM FOR ANIMAL WASTE DISPOSAL SYSTEMS

M. G. Cropsey, and P. H. Weswig
Technical Bulletin 124, Oregon State University Agricultural Experiment Station, February, 1973, 11 p., 9 tab., 9 ref.

Descriptors: *Douglas fir trees, *Bark, *Trickling filters, Farm wastes, Waste disposal, Biological oxygen demand, Nitrogen, Phosphorus, Turbidity
Identifiers: *Animal waste disposal systems, Total solids

Douglas-fir bark, 3/4 inch and 1½ inch in size, was tested in recirculating trickling filter 1, 2, and 3 feet in depth, hydraulically loaded at 2.27, 4.54, and 9.08 gallons per minute per square foot (gpm/sq.ft.) with 2 and 4 percent poultry manure slurry at 70°F. Preliminary tests indicated the necessity of allowing the heavier waste particles to settle by gravity. Samples collected at the beginning and at intervals during the run indicated that the reduction of biological oxygen demand (BOD) followed close to the formula $BODt=BOD_{0}10^{-kt}$. Also, as the depth of filter and the rate through the filter increased, the rate of removal of total solids increased. However, the rate of flow through the filter had little effect upon nitrogen removal, as this was influenced by the length of time circulated and the depth of the filter bed. BOD and the total solids concentrations lowered at a faster rate when the larger bark was used. There was no indication that the bark increased in either nitrogen or phosphorous during the tests. The turbidity on an average improved from 75 to 4.3 JTU (Jackson turbidity units) for the 2 percent concentrations and from 157 to 16.4 JTU for the 4 percent concentrations in 23 hours. (Cropsey and Weswig-Oregon State University)

### 1475-A2, A4, A7, B1, F2

### POLLUTION CONTROL REGULATIONS FOR CATTLE FEEDING STATES

Oklahoma State University
M. Paine, and J. Sweeten
Feedlot Management, Vol. 15, No. 12, p. 42-44, November, 1973, 1 fig.

Descriptors: *Air pollution, *Cattle, *Runoff, *Waste water disposal, Feed lots
Identifiers: Feeding

In 1972, Congress passed the Federal Water Pollution Control Amendments Act which gave the Environmental Protection Agency new powers to control discharges from feedlots. Effective July 5, 1973, feedlots with a capacity of 1,000 head were to be required to apply for a permit to "discharge" into navigable waters. By October 18, 1973, EPA was supposed to establish "effluent limitations" for existing feedlots and "standards of performance" for new feedlots. This would mean that no water from the feedlot should enter public waters, unless an unusually large storm causes runoff. EPA's draft report proposed no discharge of process waste waters to navigable water bodies by July, 1977, except for precipitation events in excess of the 10-year, 24-hour storm. By 1982, no discharge would be required except for precipitation events in excess of the 25-year, 24-hour rainfall. All new feedlots would be required to contain the 24-year, 24-hour rainfall. (Drewry-East Central)

### 1476-A4, A6, A7, A12, F2

### IOWA WATER POLLUTION CONTROL COMMISSION

Iowa State Department of Health
Des Moines
U. Agena
Iowa Water Pollution Control Commission, 1971, 13 p. 5 tab.

Descriptors: Water pollution control, *Air pollution, Odor, Pollutants, Livestock, Poultry, Confinement pens, Regulation, Iowa, Permits, Waste disposal, Agricultural runoff
Identifiers: *Iowa Water Pollution Control Commission, Confinement feeding

Iowa has established separate agencies to deal with air and water pollution. The Iowa Air Pollution Control Commission has authority to regulate air pollutants, including odorous substances. Its activities are presently concentrated on establishing and enforcing regulations to control air pollutants felt to have public health implications. The Iowa Water Pollution Control Commission was established to prevent, abate, and control water pollution throughout the state of Iowa. Increased attention is now being given toward control of pollution caused by livestock and poultry operations. Copies of the existing Iowa Water Pollution Control Commission cattle feedlot regulations and the proposed regulations for other animal feeding operations are attached. The regulations are divided into two major types of operations, open feedlot and confinement feeding operations. These are defined and regulations are given in detail for both. (Cartmell-East Central)

### 1477-A6,B2,B3,C2,D3,E2,E3,F1

### AGRICULTURE WASTE UTILIZATION VERSUS DISPOSAL

Management Consultant
DEKALB AgResearch, Inc.
DeKalb, Illinois

Descriptors: *Waste disposal, *Farm wastes, *Agriculture, Livestock, Poultry, Drying, Odor, Sludge, Nitrogen, Phosphorus, Moisture, Lagoons, Feeds, Recycling, Waste treatment, Methane, Research and development
Identifiers: *Waste utilization

The problem of agricultural waste disposal is a four point problem of: bird and animal concentration; changes in management systems; urban society moving to the source of production; and an awareness of society's right to clean air and water. Most people feel that keeping manure dry is the only method that should be used for maintaining odor control. This may be done by transferring moisture away from the manure particle by air movement and/or heat. If composting would take place within the building, the water from the fresh manure could be utilized for the aerobic bacteria. Handling manure wet, or by the hydraulic method is the easiest and simplest way of getting it out of the house. The problem is the anaerobic or septic odors in the lagoon or on spreading of the sludge on the land. A plastic bubble might be put over the lagoon to collect the methane gas for the operation of the electric generation equipment for the farm. The true value of all the manure produced by laying hens in the United States, based on 8 cents/pound of N, 5 cents P, and 6 cents K, is $40,000,000/year, besides the value of trace elements and humus. Livestock wastes could be pasteurized and processed so they could be a source of feed nutrients. Michigan State has indicated in a preliminary report that it appears that processed poultry nutrients are about equal to corn in value with no residue of either pathogens or chemicals. (Solid Waste Information Retrieval System)

### 1478-A6,B2,D2,D3,E2,E3

### FARMS ARE NOT OUT IN THE COUNTRY ANY MORE

Communications Center
New Jersey Agricultural Experiment Station
C. J. Teller
Compost Science, Vol. 11, No. 1, p. 8-9, January-February, 1970, 2 fig.

Descriptors: *Waste disposal, *Livestock, *Farms, *Farm wastes, Recycling, Aeration, New Jersey, Research and development, Dairy industry, Hogs, Odor
Identifiers: *Suburban areas, Land disposal, Composting, Soil conditioner, Plowing

Dairy farms in New Jersey adjoin industrial parks and only the width of a highway separates a South Jersey hog farm from a new housing development. A series of projects is being carried out at the Rutgers College of Agriculture and Environmental Science concerning the problems of agricultural solid wastes in today's suburban society. A special "Animal Waste Disposal Task Force" was organized with representatives from 23 local, State, and Federal public and private agencies and organizations interested in animal waste disposal. Environmental scientists, engineers, and soil chemists are studying the feasibility of incorporating manure into the soil. Equipment has been developed for making a furrow, placing manure in it, then covering the manure and opening another furrow all in the same operation. The feasibility of composting manure has also been investigated. The first trial is now under way, utilizing a roto-shredder to aerate the windrows. It is not expected that composting will turn out to be a profit-making venture. Dairy and hog farmers may have to sell it at about half what it costs to make it in order to dispose of manure. The composition of odors and flavors is being studied and a project that will utilize fungi to convert carbohydrate waste into protein supplement is being considered. Walker-Gordon Farm in Plainsboro has been drying manure, mixing it with cocoa shells to deodorize it, and selling the mixture as a soil conditioner. (Solid Waste Information Retrieval System)

## 1479-A8, E2, F1
### CHICKEN MANURE: AN EFFECTIVE, SAFE RANGELAND FERTILIZER
M. Franz
Compost Science, Vol. 12, No. 2, p. 14-15, March April, 1971. 1 fig. 1 tab.

Descriptors: *Poultry, *Farm wastes, *Fertilizers, Costs, California, Forage grasses, Waste disposal
Identifiers: *Chicken manure, *Rangeland

A report entitled 'Fertilization of Annual Rangeland with Chicken Manure' is summarized. Four plots were treated with: (1) no fertilizer; (2) one ton chicken manure per acre; (3) two tons; and (4) four tons. The mean yields in excess of the control plot (1) were (2) 1,422 lb; (3) 2,263 lb; and (4) 3,533 lb. To spread the poultry manure on land costs from $3.10 to $4.35 per ton. The extra feed has a value of $5.00; thus a profit can be realized. The forage produced is of a higher quality, and is available for longer periods. This type of fertilization shows promise in areas close to a source of supply. (Solid Waste Information Retrieval System)

## 1480-A8, C2, E2
### FATE OF NITRATE FROM MANURE AND INORGANIC NITROGEN IN A CLAY SOIL CROPPED TO CONTINUOUS CORN
Department of Plant and Soil Science
Vermont University
Burlington
J. M. Kimble, R. J. Bartless, J. I. McIntosh, and K. E. Varney
Journal of Environmental Quality, Vol. 1, No. 4, p. 413-415, October-December, 1972. 5 fig, 1 tab, 6 ref.

Descriptors: *Nitrates, *Farm wastes, Nitrogen, Fertilizer, Crops, Leaching, Denitrification, Sampling, Soil profiles
Identifiers: *Manure, *Corn, *Inorganic nitrogen, *Clay soil

Effects of dairy manure and nitrogen fertilizer were studied on plots that had received in a factorial arrangement two levels of manure (0 and 66 metric tons per hectare) and two levels of nitrogen (0 and 224-kg per hectare) applied every spring for 6 years. Laboratory incubation studies using soil profile samples showed potential denitrification to be greater in soil from the manure treated plots than in plots receiving either inorganic nitrogen or no nitrogen. The amount decreased with depth to 96 cm, below which energy for anaerobic microbial activity appeared to be limiting. Laboratory analysis of profile samples indicated decreasing nitrate-nitrogen-to-chloride ratios at all depths from fall to spring, suggesting that denitrification rather than leaching was responsible for a significant portion of the nitrate loss during this period. Abrupt decreases in the nitrate-nitrogen-to-chloride ratios from the surface to the 45 to 71 cm depth indicated that denitrification had taken place and that a nitrate bulge at 96 to 122 cm probably was caused by denitrication above that depth. The results indicate that more nitrate was lost by leaching when nitrogen was applied as ammonium nitrate than when applied as dairy manure, both because there was more nitrate in the profile and because it was less susceptible to denitrification. (Solid Waste Information Retrieval System)

## 1481-A8, A12, E2, F4
### FERTILIZERS, CROP QUALITY, AND NUTRIENTS IN WASTES
J. Goldstein
Compost Science, Vol. 14, No. 3, p. 9-11, May/June, 1973.

Descriptors: *Fertilizers, *Crops, *Nutrients, *Farm wastes, Organic wastes, Agriculture, Waste disposal, Foods, Quality control
Identifiers: *Crop quality, Composting, Chemical fertilizers, Health, Soil conditioner

This article describes a study being conducted at West Virginia University on what effects fertilizer applications have on plant composition and the animals consuming the food. Early findings raise questions about deficiencies developing in foods that can cause widespread human health problems. The American public is being alerted to the problem by being shown the direct effect of fertilizers on the food it is buying. A survey of the literature is provided which presents varied viewpoints on the use of chemical fertilizers. (Solid Waste Information Retrieval System)

## 1482-A6, A10, B4, D3, F1
### INDIANA POULTRYMEN ARE COMPOSTING POULTRY MANURE
Extension Poultryman
Purdue University
Lafayette, Indiana
J. G. Berry
Compost Science, Vol. 12, No. 1, p. 4-5, January-February, 1971. 3 fig.

Descriptors: *Poultry, *Farm wastes, Costs, Indiana, Waste treatment, Odor, Waste storage, Ventilation, Aeration, Waste disposal
Identifiers: *Composting, *Manure, Flies, Deep-pit system

Poultrymen in Indiana have found a method of composting poultry manure that redutes labor costs, and virtually eliminates fly and odor problems. Laying hens are housed in cages or on slats above storage pits in which the droppings are collected. If the pit is kept dry, there is no odor at all. One pit, in operation for 6 years, had a 34-in. deep compost, which was dry to a depth of 18 in., and moist below. This system is generally successful, and where problems occur, they are not as great as those resulting from handling manure by 'conventional' methods. (Solid Waste Information Retrieval System)

## 1483-A5, F4
### GROUND WATER POLLUTION IN THE SOUTH CENTRAL STATES
National Ground Water Research Program
Robert S. Kerr Environmental Research Laboratory
Environmental Protection Agency
Ada, Oklahoma
M. R. Scalf, J. W. Keeley, and C. J. LeFevers
Environmental Protection Agency report number EPA-R2-73-268, June 1973. 183 p. 23 fig, 15 tab, 387 ref.

Descriptors: *Ground water, *Water pollution, Water resources, Natural pollution, Oil-field brines, Over-pumping
Identifiers: *South-Central United States, Arkansas, Louisiana, New Mexico, Oklahoma, Texas

A study was conducted to determine the ground-water pollution problems in the states of Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. Information was obtained through review of the literature and through interviews with engineers, scientists, and government officials concerned with water pollution in the five states of the project area. Natural salinity was the greatest factor affecting the quality of ground water of the region. Disposal of oil-field brines was the most widespread source of man-made pollution. Other causes of ground-water pollution included poor well construction and abandonment procedures, over-pumping, irrigation return flows and land disposal of solid and liquid wastes. (Scalf-R. S. Kerr Environmental Research Lab.)

## 1484-C2, E2, F1
### FERTILITY
Crops and Soils Magazine, Vol. 25, No. 1, p. 23, October, 1972. 1 fig.

Descriptors: *Fertility, *Fertilizers, *Waste disposal, Economics, Cattle, Waste storage, Agriculture, Nitrogen, Phosphorus, Potassium
Identifiers: *Manure, Chemical fertilizers, Spreading

This article discusses manure's cash value as a fertilizer. One cow will produce about 15 tons of manure per year which contains nitrogen, phosphorus and potassium. If one purchased this much fertilizer commercially it would cost about $30. However, when manure is spread in the open almost any time of the year it will lose about a third of its original value. Spreading the manure in the winter will increase the losses. The main losses come from spreading, not storing, so it is best to plow the manure down as soon as possible after spreading. Therefore, the best method to use would be to store the manure all year and spread it just before fall plowing. (Solid Waste Information Retrieval System)

## 1485-B2, B3, D1, D3
### TREATMENT OF AGRICULTURAL WASTES
E. R. E. Briscoe
Effluent Water Treatment Journal, Vol. 9, No. 8, p. 439-446, August, 1969. 3 tab.

Descriptors: *Waste treatment, *Farm wastes, *Livestock, Slurries, Lagoons, Oxidation Lagoons, Aeration, Drying, Food processing industry, Irrigation, Water pollution
Identifiers: *Great Britain

Wastes from livestock farming and from vegetable washing and packaging are of immediate concern because of the nature of the latter polluting material and the large volume of liquid used in the process. The four general methods of dealing with the excreta from livestock in Great Britain are: dry-handling, semi-dry handling, semi-liquid handling, and liquid manure irrigation. It has been demonstrated by practical experiment that comparatively simple forms of extended aeration systems are capable of dealing with the slurries from calves, pigs, and hens. Other experiments have involved a combination of lagoon with oxidation ditch below slatted floors of a pig house, an aeration system using large bubbles, poultry manure drying, and a portable oxidation ditch. The waste from vegetable washing and packing is largely seasonal and varies considerably in strength. The practice of passing this type af waste through settlement is no longer providing a satisfactory solution. From research work, it would appear that pre-screening down to 52 or even 100 mesh is worthwhile in the case of all root crops. Biological treatment could take the form of extended aeration, or high-rate filtration units using plastics medium with re-circulation, in each case possibly followed by lagoons. (Solid Waste Information Retrieval System)

## 1486-A5, B1, C2

### REDUCING FEEDLOT NITRATES IN YOUR GROUND WATER

J. R. Watson
Crops and Soils, Vol. 24, No. 3, p. 17-18, December, 1971. 4 fig, 1 tab.

Descriptors: *Nitrates, *Feed lots, *Groundwater pollution, Soil profiles,, Nebraska, Leaching, Sampling

The U.S. Department of Agriculture, the Agricultural Research Service and Soil and Water Conservation scientists, and the Department of Agronomy at the University of Nebraska have been studying the movements of nitrates and other solubles in soil profiles under beef cattle feedlots. In general, oxygen and nitrogen concentrations are considerably depleted, while carbon dioxide and methane are plentiful. The ammonium-nitrogen and total nitrogen concentrations are higher near the surface, although there were no nitrates found. To guard against the possibility of nitrate leaching, however, the following procedures are recommended to all cattle farmers: avoid frequent and excessive scraping of the feedlot surface, and leave the surface soil relatively undisturbed when removing manure from the feedlot. On-lot decomposition is encouraged. In this way, leaching of the soil will be minimized as will its oxygen concentrations. Low oxygen concentrations are desirable since oxygen interferes with the reducing environment in which nitrates are converted to harmless nitrogen gas. (Solid Waste Information Retrieval System)

## 1487-A5,A6,A8,A10,D3,E1,E2 E3

### BIOLOGICAL TREATMENT OF POULTRY MANURE REDUCES POLLUTION

Harni Road
Baroda, India
J. D. Patel, and R. B. Patel
Compost Science, Vol. 12, No. 5, p. 18-20, Sept.-Oct., 1971. 2 fig.

Descriptors: *Waste treatment, *Farm wastes, *Poultry, *Biological treatment, *Aerobic conditions, Anaerobic conditions, Gases, Fuels, Effluent, Fertilizers, Odor, Flies, Reclamation.
Identifiers: *Manure, *Pollution, India, Digestor, Malaria, Pollution control

Animal and poultry wastes can be converted either aerobically or anaerobically into valuable soil amendments, with the former method being used for wastes with low organic solids. With the latter method, which is used to treat poultry manure at Papcock Farms of Baroda-6, India, the manure is mixed with water, after which it undergoes a 3-day digestion process consisting of first liquification then gasification. The gaseous end-products are primarily carbon dioxide and methane, with small quantities of ammonia,' hydrogen sulphide, nitrogen, hydrogen and oxygen. These gases are utilized as fuel to run the incubator with a capacity of 4,224 eggs, a small gas engine, the incubator fans, and in domestic cooking. A low BOD effluent is also produced, which has no odor and can be diverted to a municipal sewer, or sold as farm manure. As a fertilizer, the effluent provides a stable, well-balanced product, which contains humus nitrogen-giving blue-green algae are used on the drying effluent to increase the nitrogen content of the final product, and to prevent the breeding of the malaria carrier. Further, the digestion process destroys all fly larvae and pathogenic organisms, as well as rendering end-products which do not contribute to air, ground-water, or soil pollution. The operation of the digestor is described in detail. (Solid Waste Information Retrieval System)

## 1488-A8,B3,C1,D1,D3,E2,E3

### NEW USES FOR POULTRY MANURE?

Compost Science, Vol. 11, No. 4, p. 19, July-August, 1970.

Descriptors: *Poultry, *Farm wastes, *Recycling, Feeds, Fertilizers, Ventilation, Drying, Organic wastes
Identifiers: *Great Britain, Composting, Soil conditioners

In Great Britain, poultry droppings are being fed to sheep and beef cattle in diets containing 12½ and 25 percent dried manure, while derelict, abandoned lands around coal fields are being reclaimed and restored through manure application. New developments in poultry house ventilation and management are drying poultry manure as well as the litter so that the total moisture content of the product is less than 30 percent to 20 percent by weight. This drying in the house encourages the action of aerobic bacteria and composting to take place. Dry manure is being sold in bulk to mix with other organics to improve a mix of bagged organic fertilizer. Most Pennsylvania poultrymen still use poultry manure as a soil conditioner along with lesser amounts of commercial fertilizer on farm crops. Poultry manure dried in the poultry house shortly after it is produced has the highest fertilizer value that any poultry manure can have. Dry poultry manure causes fewer farm problems with flies, odor, gas and spreading than wet or liquid manure. Using the manure as feed, there are obvious dangers of transferring diseases from poultry to other livestock. Also, the animals would have to be given time for the microflora of the rumen to adjust to the new diet. Researchers at a center of the National Agricultural Advisory Service at Llanishen, Cardiff, began with glasshouse experiments, mixing Italian rye grass with battery hen slurry and applying it to tip material on a tray. Germination was poor initially. But when broiler litter was tested in the same way, germination was as good as with conventional fertilizer. (Solid Waste Information Retrieval System)

## 1489-D3, E3

### MANURE POWER — AN OVERLOOKED ENERGY SOURCE

D. A. Harter
Pennsylvania Township News, p. 28-30, October, 1973. 3 fig.

Descriptors: *Energy, *Farm wastes, *Methane, *Waste treatment, *Waste disposal, *Recycling, Cattle, Poultry, Water, Sewage bacteria, Ornanic wastes, Pennsylvania, Vermont
Identifiers: *Manure, *Anaerobic digestor, Ignitable gas, India, South Africa

The Environmental Improvement Committee for Pennsylvania Agricultural Progress Days (held August 28-30 in Hershey) built an experimental, anaerobic digestor to demonstrate the process of converting animal manure to methane gas. They started with 30-, 40-, and 50-gallon steel drums, some angle irons, a few gas pipe fixtures, a gas light element, an electric heating element, some chicken manure, and began to assemble a generator. After research and experimentation, they found that the gas produced by their slurry was about 72% methane, 18% carbon dioxide, and 10% other gases. A "log" record indicated an average daily production of about 2.5 cubic feet of gas throughout the six-week period needed for complete digestion of the organic wastes. Experimental data showed 10 cubic feet of methane could be generated from two to three pounds of dry animal waste. (Ballard-East Central)

## 1490-B1, F6

### A MATHETICAL SIMULATION OF ENVIRONMENTAL CONTROL IN SWINE BUILDINGS

L. D. Good
M. S. Thesis, Purdue University, Department of Agricultural Engineering, 1971, 58 p. 2 fig, 9 tab, 15 ref, 5 appendices
Descriptors: *Environmental control, *Swine, *Buildings, *Mathematical models, Mathematical studies, Confinement pens, Computer models, Computers, Temperature, Humidity, Heat, Ventilation, Weather, Input-output, Analysis
Identifiers: *Mathematical simulation, Experimental data

The objective of this project was the development of a mathematical model and computer program to facilitate the simulation of the environment in confined swine buildings. An additional objective was the design of input and output forms and formats to make the model accessible to interested persons. On the basis of outside temperature and relative humidity, the building, ventilation control and habitation, the mathematical model which has been developed will predict the inside temperature, relative humidity, the occurrence of condensation on walls, weight gained by the livestock and the amount of energy utilized for ventilation and heating. Input and output forms were designed to facilitate the use of this model by persons not necessarily familiar with or having access to computer facilities. The input forms allow the model to be flexible while the output attempts to present the results in a simple concise form for use by non-technical people. (Cartmell-East Central)

## 1491-B1, D1, D2, D3, E3

### METHANE RECOVERY FROM CHICKEN MANURE DIGESTION

C. W. Savery and D. C. Cruzan
Journal Water Pollution Control Federation, Vol. 44, No. 12, p. 2349-2354, December, 1972. 2 fig, 9 ref.

Descriptors: *Methane, *Poultry, *Farm wastes, *Digestion, *Waste treatment, *Waste disposal, *Recycling, Anaerobic conditions, Aerobic conditions, Drying, Incineration, Thermophilic bacteria, Energy
Identifiers: *Manure, Total energy system

To provide preliminary design data for a farm total energy system fueled by methane produced by bacteria, an experimental anaerobic digester was built and daily gas production rates and compositions were determined for loadings of fresh chicken manure. Fresh chicken manure was digested in an experimental 35-1 capacity anaerobic digester. Batch reactor operation in the thermophilic bacteria range at 51°C produced 130 1 of gas (60 percent methane)/kg of wet manure reacted. Attempts to operate the anaerobic digester at 51°C in a continuous flow, well-stirred mode with hydraulic retention times of 4, 5, and 6.7 days resulted in retarded digester operation. Anaerobic processing in conjunction with aerobic digestion, drying, or incineration offers promise of economic waste treatment of chicken manure, particularly if incorporated with a farm total energy system fueled with the recovered methane. (Cartmell-East Central)

## 1492-A11, C1, C3, D3

### BROILER LITTER SILAGE FOR FATTENING BEEF ANIMALS

Department of Poultry Science
Texas Agricultural Experiment Station
Texas A&M University
College Station, Texas
C. R. Creger, F. A. Gardner, and F. M. Farr
Feedstuffs, Vol. 45, p. 25, January 15, 1973. 4 tab.

Descriptors: *Waste disposal, *Feeds, Cattle, Poultry, Recycling, Pathogenic bacteria, Fermentation
Identifiers: *Broiler litter silage, Drugs, Trace minerals, Fattening

Broiler litter on pine shavings was ensiled at 35-38 percent moisture content in an airtight silo for six weeks then fed with a 12 per cent protein mix ad libitum to heifers for 120 days. The calves gained 2.54 lb per head per day. No drug carryover of any consequence occurred. Pathogens were eliminated by the heat of ensilage. A taste panel expressed some preference for steaks from control cattle but found the litter-fed beef highly acceptable. (Whetstone, Parker, and Wells — Texas Tech University)

### 1493-A11
## MEADOW FORAGE QUALITY, INTAKE, AND MILK PRODUCTION OF COWS
Department of Animal Science
Colorado State University
C. L. Streeter, et. al.
Journal of Range Management, Vol. 27, No. 2, March 1974, p. 133-135, 1 fig, 3 tab, 15 ref.

Descriptors: *Forage grasses, *Cattle, *Nutrients, Sampling, Nitrogen, Diets, Colorado
Identifiers: *Meadows, *Milk production, In vitro digestibility, Dry matter, Animal wastes, Bluegrass, Chromic oxide

This study was conducted to determine seasonal changes in nutritive value of forage consumed and the amount of milk produced by four breeding groups of cows grazing native mountain meadows. The experimental area was located 6 miles north of Gunnison, Colorado. Nutrient concentration and digestibility were measured. Fecal excretion was estimated using chromic oxide as an external indicator. Milk production was measured every 14 days by measuring calf weights before and after nursing, followed by weighing milk obtained by machine milking. Continuously grazed irrigated meadows produced forage high in nitrogen. There was little or no decline in dry matter intake as the season progressed. Continuous grazing of the meadow could eventually reduce the vigor of bluegrass because of heavy pressure on bluegrass sites. Conclusions concerning differences among breeding groups were given but must be regarded as tentative because of limited numbers. (Cartmell-East Central)

### 1494-B1, D1, D3
## POWER REQUIREMENTS OF A COMPOST CHANNEL FOR ANIMAL WASTES
Agricultural Engineering Department
Maryland University
College Park
J. W. Hummel, W. F. Schwiesow, and G. B. Willson
Transactions of the ASAE, Vol. 17, No. 1, p. 70-73, January-February, 1974. 3 fig., 3 tab, 6 ref.

Descriptors: *Farm wastes, *Waste treatment, Anaerobic bacteria, Aerobic bacteria
Identifiers: *Animal wastes, *Composting, Mechanical Agitation

Composting of waste materials has been done for many years with small amounts of waste being processed at slow rates under anaerobic conditions. But research has determined that when sufficient oxygen is available, decomposition is accomplished faster and with no offensive odor when aerobic bacteria influences the process. Interest in finding a proper mechanical aerobic compostor stimulated this experiment. The experiment channel was constructed out of plywood 37 ft. long and elevated 3 ft. An elevating mechanism was designed to agitate, mix and transport the composting mass the length of the channel. The channel used in the experiment appears to be a promising system for composting agricultural wastes. Actual power measurement data indicated that the carriage used is even heavier than necessary. The artificial test material used was adequate in establishing the effects of design changes on the power requirements of the system, but actual waste material or test matertals more closely resembling waste materials are necessary to determine actual power levels. (Russell-East Central)

### 1495-A11, D1, E3
## THE EFFECT OF INCORPORATING HEN MANURE INTO THE DIET OF YOUNG CHICKS
Department of Poultry Science
Florida Agricultural Experiment Station
Gainesville
D. R. Sloan, and R. H. Harms
Poultry Science, Vol. 52, No. 2, p. 803-805, March, 1973. 3 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, Diets, Feeds, Proteins, Growth rates, Performance, Waste treatment, Waste disposal
Identifiers: *Refeeding, Manure, Chicks, Air-dried hen manure, Feed efficiency, Growth depression, Uric acid, Feed consumption

A study was conducted to determine the effect of adding air-dried hen manure to a chick diet. Two experiments were conducted using 720 day-old broiler-type chicks. In the first experiment, protein levels of 16, 20, and 24% were fed with five levels of hen feces. Manure was substituted on a pound for pound basis in the basal diet. Diets used in the second experiment contained either 20, 24 or 28% protein with three levels of manure, and 2 levels of sand. A decrease in growth was obtained with each increase in manure level. The incorporation of the manure at any level of protein was detrimental to weight gain. A decrease in growth and feed efficiency was obtained by adding either 5 or 10% hen manure to the feed. The addition of 5% sand did not influence growth or feed efficiency. When the level of sand was increased 10%, a significant growth depression was obtained when the diet contained only 20% protein. However, growth was not depressed at levels of 24 or 28% protein. It would appear that some factor is present in air-dried hen manure, perhaps uric acid, which masks the birds ability to eat and meet its energy requirements, thus having a depressing effect upon body weight gain and decreasing feed utilization. (Cartmell-East Central)

### 1496-B1, E1, E3
## MANURE, HOW IT WORKS
Civil Engineering Department
Water Resources Center
Texas Tech University
Lubbock
D. M. Wells, G. A. Whetstone, and R. M. Sweazy
Presented at the American National Cattlemen's Association—EPA, Action Conference, Denver, Colorado, August 28-29, 1973. 2 tab, 14 ref.

Descriptors: *Farm waste, *Waste treatment, *Waste disposal, Recycling, Odor, Economics, Feed lots, Cattle, Fertilizers, Chemical properties, Physical properties, Fuels, Methane, Oil, Gases
Identifiers: *Manure, *Waste utilization, Refeeding, Gas synthesis, Composition, Land disposal

Due to the large quantities of manure being produced by modern feedlots, the feeder is faced with either a huge problem or a huge potential resource. Manure can be used beneficially in a number of ways, but it has a negative value in virtually all the methods of utilization currently in widespread use. Manure is composed of a variety of compounds, and the sum product of the breakdown of these compounds is usually on odorous process. However, research is being conducted to find ways to control and decrease the negative qualities of manure. One of the most promising projects currently underway is the synthesis gas project. Other valuable projects are experimenting with direct refeeding of wastes. Other techniques have been devised for disposing of manure cheaply, and these processes will probably gain more attention until more sophisticated systems come into widespread use. (Russell-East Central)

### 1497-A8, B1, E2
## MANURE GOOD 'PINCH HITTER' FOR COMMERCIAL FERTILIZER
Feedlot Management, Vol. 16, No. 4, p. 26, April, 1974

Descriptors: *Fertilizers, *Phosphorus, *Potassium, *Nitrogen, *Saline soils, *Farm wastes, *Waste disposal, Livestock, Feed lots
Identifiers: *Manure, *Land application, Loading rates

Because of rising fertilizer costs, more and more interest is being generated for using manure from livestock feeding operations as a plant nutrient source. Tests were conducted using manure as a fertilizer source and it was found that 10 to 15 tons per acre is enough for most crops and anything over 20 tons would not be beneficial. The main drawbacks of using manure as fertilizer are the high costs of hauling and applying the waste, the possibility of introducing noxious plants to uncontaminated fields, the buildup of salt in the soil, and the buildup of phosphorus in the soil. Long term effects are hard to evaluate, but at the present with moderate application rates no problems are forseen. Above all, research has indicated that with proper application and management of wastes, excellent crop growth can be achieved. (Russell-East Central)

### 1498-A2,A4,B4,D1,E2,F1,F2
## MENACING RUNOFF CONTROLLED WITH LAGOON SYSTEM
Feedlot Management, Vol. 15, No. 5, p. 13-14, May, 1973

Descriptors: *Agricultural runoff, *Water pollution control, *Lagoons, *Waste storage, *Waste disposal, Farm wastes, Fertilizers, Feed lots, Dikes, Settling basins, Regulation, South Dakota
Identifiers: Land disposal, Screening

Runoff from commercial feedlot operations, such as that of the Thormodsgaards in South Dakota, creates many environmental hazards. To deal with these hazards the government has passed stringent anti-pollution regulations. To meet these regulations the Thormodsgaards had to take effective control measures to correct their problem. The American Soil Conservation Service (ASCS) aided them in developing an operation which would meet these regulations. Dikes were erected which would prevent field water from running through the feedlots and the water directly from the lots was diverted to a settling basin. It was then passed through a screen into a retention pond. When the retention pond became too full, the water was pumped onto adjoining land. Each summer the settled wastes were removed and spread on land as fertilizer. The Thormodsgaards feel that the wastes are not a replacement but a supplement to their fertilizer program. Total cost of the operation is about $6,500 with ASCS paying 80% of the cost. With this type of pollution control it is hoped that feedlots will decrease their amount of pollutant discharge into streams and rivers. (Russell-East Central)

### 1499-A4, B1, E2, F2
## ECONOMIC COSTS OF WATER QUALITY PROTECTION ON DAIRY FARMS
Department of Agricultural and Food Economics
Massachusetts University
M. Ashraf, and R. L. Christensen
Paper presented at Joint Regional Meeting of The Northeast Division of ADSA and the Northeast Section of ASAS, Kingston, Rhode Island, July 15-17, 1973, 18 p. 1 fig, 9 tab, 5 ref.

Descriptors: *Costs, *Economics, *Dairy industry, Waste storage, Waste disposal, Water pollution, Nutrients, Water quality control, Labor, Cattle
Identifiers: *Water quality protection, Stacking, Land spreading, Stanchion dairy operation, Freestall dairy operation

Nutrient pollution of surface waters from animal sources is a major public concern. Alternative systems of manure disposal (such as liquid storage or stacking) could be utilized to minimize the pollution effect. Such changes result in investment costs of three to five times higher than daily spreading systems. Smaller farms with a lot of pasture land experience a smaller impact on farm income as compared with larger free stall farms where pollution control systems are used. The selection of a particular system is directed by such factors as: slope of farm land, soil type, amount of rainfall, and the present level of water pollution. The choice of a system is also dependent upon imposed regulations. Once pollution regulations are imposed on a given farm, it is then possible to specify a system which would conform to these regulations and have minimum income impact. (Russell-East Central)

## 1500-A6

### ODOR MEASUREMENT FOR LIVESTOCK FEEDING OPERATIONS

Texas Agricultural Extension Service
Texas A&M University
College Station
J. M. Sweeten, D. L. Reddell, and H. B. H. Cooper
Presented at Specialty Conference on Control Technology for Agricultural Air Pollutants, Air Pollution Control Association—Southern Region, Memphis, Tennessee, March 18-19, 1974. 25 p. 8 fig, 8 tab, 25 ref.

Descriptors: *Odor, *Confinement pens, *Farm wastes, Livestock, Air pollution, Hogs
Identifiers: *Odor control, *Odor measurement, Scentometer, Intensity, Organoleptic tests, Vapor dilution, Liquid dilution, Matching standards tests

Odors are easy to detect, but hard to solve in livestock feeding operations. The key to odor control is odor measurement. This report contains reviews of techniques used in odor detection and measurement. The methods presented which measure odor intensity include static and dynamic vapor dilution, liquid dilution, and matching standards tests. Results of experiments measuring odor intensities at cattle feedlots are presented. Also case studies involving scentometer readings are presented for a liquid manure system for swine, an open lot swine operation, and a confinement cattle feeding facility. With these case studies are conclusions and suggestions concerning effective odor abatement. Many areas of research concerning odor which need to be studied are also reviewed. (Russell-East Central)

## 1501-A2, B1, B4, E2, F1

### ECONOMIC IMPACTS OF APPLYING SELECTED POLLUTION CONTROL MEASURES ON MICHIGAN DAIRY FARMS

D. L. Good, C. R. Hoglund, L. J. Connor and J. B. Johnson
Michigan State University Agricultural Experiment Station Research Report 225, November, 1973, 12 p. 12 tab, 12 ref.

Descriptors: *Economics, *Dairy industry, *Michigan, *Agricultural runoff, Waste storage, Waste disposal, Labor, Dikes, Feed lots, Costs, Investment
Identifiers: Pollution control, Subsurface disposal, Soil injection, Stanchion housing, Open lot housing, Cold covered housing, Warm enclosed housing

The economic impact of three selected control measures was analyzed. The control measures were: (1) mandatory control of surface runoff from the production site; (2) prohibition of winter spreading of dairy wastes; and (3) mandatory subsurface disposal of dairy wastes. The net effect of the labor required for the entire year for application of these pollution control measures would be the reduction of the total annual hours of labor needed for the adjusted systems. Results from using facilities to control surface runoff indicate that production costs would be elevated. Also compliance with the no winter spreading and subsurface disposal of wastes would again elevate production costs. The effect of complying with all three pollution control measures would increase costs by twenty-eight dollars per cow on the 40-cow dairy farm, but would be less severe on larger operations. (Russell-East Central)

## 1502-A6,A11,B3,C1,C2,E3

### TURKEY ANAPHAGE

Department of Animal Science
Michigan State University
East Lansing
H. C. Zindel
Poultry Digest, Vol. 33, No. 384, p. 72, 76. 1 fig. 3 tab.

Descriptors: *Recycling, *Waste treatment, Chemical analysis, Performance, Phosphorus, Protein, Nitrogen, Bacteria, Calcium, Sawdust
Identifiers: *Turkey anaphage, *Poultry anaphage, *Dried poultry waste, Poultry litter, Manure

Turkey anaphage is defined as a product composed of turkey excreta that has been dehydrated to reach a moisture content of 10% or less. The dehydration is also designed to destroy any pathogenic bacteria. Poultry anaphage was fed at levels of 0, 5, 10, and 30% of the ration to commercial grade large white turkeys, from 9 to 17 weeks of age. The poultry anaphage used was as follows: calcium, 6.3% phosphorus, 2.0%; crude fiber, 15.0%; ether extract, 3.4%; moisture, 6.7%; crude protein, 19.5%; non-protein nitrogen, 1.5%; true protein, 10.3%. Body weight gain for the 9 to 17 week age period was not significantly affected by feeding poultry anaphage to these growing turkeys. Research has also indicated that dryed layer hen manure has a practical application as litter for brooding and rearing turkeys, but it was hard to manage and had an offensive odor. Turkeys reared on DPW were heavier, had fewer condemnations, and fewer breast blisters. (Russell-East Central)

## 1503-A4, A6, A7, B2, B3, B4, E2, F2

### WASTE HANDLING AND DISPOSAL GUIDELINES FOR INDIANA BEEF PRODUCERS

Purdue University. Animal Waste Committee
Cooperative Extension Service Report ID-84, Purdue University, Lafayette, Indiana, 1972. 13 p. 3 fig. 3 tab.

Descriptors: *Waste disposal, *Cattle, *Farm wastes, Odor, Solid wastes, Liquid wastes, Indiana, Regulation, Water pollution, Air pollution, Design, Feed lots, Pastures, Confinement pens, Waste storage, Waste treatment
Identifiers: *Waste handling, *Guidelines, Waste disposal systems, Beef producers, Land spreading, Nuisances

Indiana's confined feeding control law and pollution laws and regulations affecting beef operations are discussed in these guidelines. The pasture, feedlot, and total confinement systems are presented with tips on design and management of beef housing systems. Types of beef waste handling and storage facilities such as solid manure, liquid manure, and partial treatment manure handling systems are also discussed. Finally, guidelines for disposal of beef cattle waste products are brought out. Tips are provided concerning land application rates and odor control during disposal. It is hoped that these guidelines will aid beef producers in designing and operating an efficient and pollution free waste disposal system. (Russell-East Central)

## 1504-B2, D1

### LIVESTOCK WASTE MANAGEMENT SYSTEMS DESIGN AND OPERATION

Agriculture Engineering Department
Nebraska University
Lincoln
E. A. Olson
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, Paper No. 73-4539, 9 p. 12 fig.

Descriptors: *Farm wastes, *Waste treatment, *Design, *Operation & maintenance, Dikes, Waste disposal, Education
Identifiers: Waste treatment systems, Debris basin, Holding pond

Simple, practical livestock waste management systems based on sound research are proving themselves effective in controlling livestock waste in Nebraska. A well coordinated educational program including the livestock industry with state and federal agencies has helped acceptance of waste management. Most waste systems generally have a method for diversion of runoff from a feedlot; for collection of runoff which is held in a debris basin; and for pumping the basin after the solids settle. However, no matter what the type of system, it is essential to have good management to assure satisfactory operation. There are two jobs that need particular attention by the feeder to insure proper waste management. These are: (1) periodic cleaning of the debris basin, and (2) pumping of the holding pond. (Russell-East Central)

## 1505-A4,A6,A9,B1,E1,F2

### LEGAL RESTRAINTS ON AGRICULTURAL POLLUTION

Army Corps of Engineers
Board of Engineers for Rivers and Harbors
Washington, D. C.
W. R. Walker
Agricultural Engineering, Vol. 51, No. 11, p. 636-637, November, 1970

Descriptors: *Legal aspects, Trespass, Pesticides, Water pollution, Waste disposal, Odor, Feed lots, Nitrogen, Lagoons
Identifiers: *Agricultural pollution, Liability, Chemical fertilizers, Private nuisance, Public nuisance, Pollution control, Legal restraints, Negligence

Due to use of confined livestock feeding operations, chemical fertilizers, pesticides and herbicides, and intensive irrigation, agriculture joins the cities and industries as a major source of pollution. Legal restraints to agricultural pollution usually involve either individual action whereby the injured party seeks redress for damages incurred by pollution or statutes and regulations by the State and Federal governments. The basis for recovery under common law involving individual action include actions for trespass, private or public nuisance, negligence, and strict liability. The most common defenses in agricultural pollution cases are the statute of limitations and prescription. Traditionally, the states establish water quality standards with the approval of the Federal government. New types of regulations such as agricultural zoning to control pesticides are being adopted by states in hopes that future agricultural pollution will be controlled. (Russell-East Central)

## 1506-A1,B1,B4,D3,E1,E2,F3

### ECONOMIC AND ENVIRONMENTAL CONSIDERATIONS IN DAIRY MANURE MANAGEMENT SYSTEMS

Department of Agricultural Economics
Cornell University Agricultural Experiment Station
New York State College of Agriculture & Life Sciences
Cornell University
Ithaca
J. J. Jacobs, and G. L. Casler
Cornell University Agricultural Experiment Station Report A. E. Res. 72-18, December, 1972, 31 p. 1 fig. 4 tab. 8 ref

Descriptors: *Economics, *Environmental control, *Dairy industry, *Farm wastes, *Waste treatment, *Waste storage, *Waste disposal, Lagoons, Water pollution, Odor, Costs, Labor, Equipment, Research
Identifiers: *Questionnaires, *Manure, Flies, Waste management system

Results of the analysis suggest that almost any realistic alternative to daily spreading will increase the cost of manure handling on dairy farms, but will not necessarily decrease the environmental impacts. Preliminary attempts to measure and aggregate the environmental impact of alternative manure handling systems indicate that the difference among systems is not as great as that implied by those who have suggested that dairymen should be doing something other than daily spreading. Storage or lagoon systems are expensive and eventually result in adverse effects on the environment. This suggests further research must be done on the environmental effects of alternative manure handling before making overall recommendations on what is the appropriate system. (Russell-East Central)

## 1507-A11, B1, F5

### SEWAGE-GROWN ALGAE AS A FEEDSTUFF FOR CHICKS

Department of Poultry Husbandry
California University
Davis
C. R. Grau, and N. W. Klein
Poultry Science, Vol. 36, p. 1046-1051, 1957. 6 tab, 8 ref.

Descriptors: *Algae, *Feeds, *Algae proteins, *Poultry, Aluminum, Flocculation, Centrifugation, Neutralization.
Identifiers: *Chicks, *Sewage-grown, Acid extraction, Tolerance

Sewage-grown algae meals, which contain about 40% crude protein, have been studied as sources of protein and other nutrients for young chicks. All feeding trials were performed with White Leghorn chicks which were fed a stock diet for ten days after hatching, and were then fed the experimental diets for the next eight days. Both alum-flocculated and centrifugated samples were fed. The chicks tolerated diets containing up to 20% aluminum-free algae meal. The presence of significant amounts of aluminum in the meal depressed chick growth. Neutralization and acid extraction have been unsuccessful in removing the harmful effects of the aluminum. The presence of dark, watery droppings was the only observed adverse effect of feeding the algae meals. This condition was found with alum-flocculated and aluminum-free meals. (Cameron-East Central).

## 1508-A6,B3,B5,C1,D3,E3

### BRIDGETON, N.J. SLUDGE COMPOSTING PROJECT—A CITY-FARM RELATIONSHIP

Biological & Agricultural Engineering
Department
Rutgers University
New Brunswick, New Jersey
M. E. Singley
Compost Science, Vol. 14, No. 5, p. 18-21, September/October, 1973. 4 fig.

Descriptors: *Hogs, *Farm wastes, *Stabilization, Oxygen, Sewage sludge, Municipal wastes, Bulk density, Odors, Recycling, Plastics
Identifiers: *Composting, Windrows, Hog Manure, Vapor generation

A program, funded by the United States Department of Agriculture, was directed toward the feasibility of rapidly stabilizing swine and reducing odors. Street refuse was used on bulking materials in the process of swine waste composting. Composted refuse, manure, and sludge were turned twice daily during tests conducted by Rutgers University. Composting time was reduced from four months to six weeks. The color changed to brown as composting continued, and the material began to look shredded. As time passed, particle size was further reduced and vapor generation declined. Bulk density readings increased as the composting process proceeded. The lowest density reading, about 19 pounds per square foot, was for the windrow that bulked at the highest rate. At the end of the composting process, all windrows were up to between 40-50 pounds per cubic foot. The composted product was then used as a soil amendment. The most difficult problem was separating plastic from the composted material to be salvaged. (Cameron-East Central)

## 1509-A8, B1, F1, D2, D3 E2, E3, F3, F4

### SYMPOSIUM ON ANIMAL WASTE MANAGEMENT

Symposium on Animal Waste Management, USDA Southwestern Great Plains Research Center, Bushland, Texas, January 18, 1973, 50 p. 11 fig, 8 tab, 21 ref.

Descriptors: *Farm wastes, *Waste treatment, *Waste disposal, Recycling, Feed lots, Cattle, Nutrients, Nitrogen, Salts
Identifiers: *Land spreading, *Pollution

This symposium was held to consider the problems of animal waste management, particularly in relation to beef cattle. Animal waste treatment and disposal were singled out in terms of recycling and land disposal. Various forms of recycling, i.e. refeeding, creating fuels, etc., are still largely experimental and in most cases are not yet feasible. While land spreading offers a much used means of waste disposal, over-supply of nutrients in the soil is a possible hazard. Research is still needed for development of non-polluting feasible means of disposing of animal wastes. (Merryman-East Central)

## 1510-A8, E2

### EFFECTS OF CATTLE FEEDLOT MANURE ON CROP YIELDS AND SOIL CONDITIONS

USDA Southwestern Great Plains Research
Center, Bushland, Texas
A. C. Mathers, B. A. Stewart, J. D. Thomas,
and B. J. Blair
Symposium on Animal Waste Management, USDA Southwestern Great Plains Research Center, Bushland, Texas, January 18, 1973, p. 1-13. 6 fig, 1 tab.

Descriptors: *Feed lots, *Cattle, *Farm wastes, *Waste disposal, *Crops, Nitrogen, Salts, Rates of application, Soil profile
Identifiers: *Manure, *Soil conditions, *Yields, Land spreading

Definite conclusions cannot be obtained from this report because only one to three years data is represented. However, this data suggests that manure applications of ten tons per acre furnish adequate nitrogen for most crops without creating high salt buildup in the soil. Also, applications of ten tons per acre do not affect organic levels of the soil. Higher rates of manure can be added to soil without lowering yields, but nitrate and salts accumulate, eventually hampering crop yields. This problem can usually be alleviated by deeper plowing depths. Conclusions on manure application suggest that at just ten tons per acre, land area in even the most concentrated feeding areas is adequate to dispose of manure. In fact, only one-fourth of the grain sorghum cropland in Texas alone would have to be treated to dispose of the manure. The challenge is to develop distributing and handling systems to spread the manure on croplands most beneficially. (Russell-East Central)

## 1511-A11, B1, B5, C2, E2

### EFFECT OF RATION ON MANURE SALT CONTENT

Texas Tech University Center at Amarillo
Pantex, Texas
R. H. Klett
Symposium on Animal Waste Management, USDA Southwestern Great Plains Research Center, Bushland, Texas, January 18, 1973, p. 26-31. 2 tab, 8 ref.

Descriptors: *Diet, *Salts, Farm wastes, Cattle, Livestock, Feed lots, Performance
Identifiers: *Manure, *Ration, *Waste management, Sodium levels, Excretion.

Data from this experiment illustrates that excessive levels of salt obtained from the diet are excreted and tend to serve no useful purpose for the nutrition of feedlot steers. Data also suggests that levels of sodium in the form of NaCL could be reduced below those normally recommended for feedlot rations without affect on annual performance. In other words, the correct amount of salt is the amount that is utilized by the animal. The excess salt serves no useful function. Also, reducing feeding levels of salt will result in lower levels of salt in solid-waste and will allow higher incorporation of manure into the soil as fertilizing material. (Russell-East Central)

## 1512-A2,A5,B2,C2,D1,E1,E2

### AMOUNTS, COMPOSITION, AND MANAGEMENT OF FEEDLOT RUNOFF

USDA Southwestern Great Plains Research
Center
Bushland, Texas
R. N. Clark, and B. A. Stewart
Symposium on Animal Waste Management, USDA Southwestern Great Plains Research Center, Bushland, Texas, January 18, 1973, p. 32-42. 3 fig, 2 tab, 6 ref.

Descriptors: *Runoff, *Feed lots, Chemical composition, Sampling, Seepage, Evaporation, Stocking, Moisture content, Playas, Salinity, Irrigation
Identifiers: *Amounts, Rainfall-runoff relationships, Waste management

Runoff amounts and concentrations were measured from a Texas High Plains cattle feedlot at Bushland. The graphic relationship between rainfall and runoff for runoff-producing storms was linear with about one-third of the rainfall ending up as runoff. Concentrations of runoff constituents were higher than those found for cattle feedlots elsewhere. This was probably due to high evaporation and high stocking rates which result in lots containing more salt. Soil moisture samples indicated that there was no significant seepage which would pollute ground water from playas or lots. Before runoff could be used for irrigation there would have to be a dilution of about four parts well water to one part feedlot runoff. This dilution would reduce salinity below levels hazardous to crops. Any use of feedlot runoff for irrigation required a close watch on salts in the water and soil. (Russell-East Central)

## 1513-A2,A4,A6,B1,D2,E2,E3, F2

### FUTURE DEVELOPMENTS IN FEEDLOT WASTE MANAGEMENT

Texas Agricultural Extension Service
Texas A&M University
College Station
J. M. Sweeten
Symposium on Animal Waste Management, USDA Southwestern Great Plains Research Center, Bushland, Texas, January 18, 1973, p. 43-50. 7 ref

Descriptors: *Feed lots, *Farm wastes, Water pollution, Recycling, Fuels, Oxidation, Odor, Runoff, Air pollution, Design, Slurries, Legal aspects
Identifiers: *Waste management, *Developments, Land disposal, Refeeding, Pyrolysis, Composting, Building materials, Soil conditioners

With rapid progress being made toward abating water pollution and with the benefits and safety of land disposal of feedlot manure, remaining problems of feedlot waste management will primarily entail developing more efficient and odor-free methods of managing solid manure and polluted runoff. Recycling waste as feed offers one method, but the Food and Drug Administration has banned this method for lack of research. Many other recycling methods such as developing manure into fuel oil have been suggested. But, at the present, these methods are economically unfeasible. Perhaps one of the most restricting problems of waste management is odor. This problem has a variety of possible solutions, but most incorporate improved feedlot design. Once the problems have been satisfactorily solved or bypassed, feedlot waste management will no longer be a pollution control issue but an economic one. (Russell-East Central)

## 1514-B1, F1

### PRIORITIES IN SELECTING DAIRY FACILITIES

Kentucky University
Lexington
G. M. Turner
Presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-415, 20 p. 1 tab.

Descriptors: *Feed lots, *Investment, *Priorities, *Facilities, *Dairy industry, Costs, Land, Water, Silage, Feeds, Planning, Cattle, Kentucky, Waste storage, Waste disposal
Identifiers: Manure handling, Feed storage, Field machinery

The reason for establishing priorities for dairy facilities is to determine which facilities are absolutely necessary in order for a maximum profit return of each investment to occur. The facilities are divided into two groups, (1) essential, and (2) additional. The essential facilities must be available before milk production can start and continue. The additional facilities lessen the time and labor load, but the margin of profit return is not as great. A list of each type of facility is given, along with an explanation of each. A discussion of the economics of investment of each of the facilities is included. The cost figures are averages from dairy farms on Kentucky Farm Analysis programs. (Cameron-East Central)

## 1515-A4, A5, C2, E2

### GROUND-WATER NITRATE POLLUTION IN RURAL AREAS

Illinois State Water Survey
Champaign
W. H. Walker
Illinois State Water Survey, Champaign, Illinois, 1973, 8 p. 1 fig, 3 ref.

Descriptors: *Groundwater pollution, *Nitrates, *Rural areas, Fertilizers, Farm wastes, Waste disposal, Sampling, Illinois, Chemical analysis, Aquifers, Groundwater recharge
Identifiers: Land application

Chemical analyses of samples collected throughout Illinois indicate that, especially in the rural areas, nitrate pollution of surficial aquifers is widespread. Nitrates readily enter the surficial aquifers during non-growing season precipitation recharge periods. The nitrates then slowly move through the aquifer to wells, streams, and drainage areas. However, little mixing with ground-water appears to occur. Studies also indicate that trees and plants store nitrates during the growing season and release them during non-growing seasons. In light of studies concerning nitrates, it seems necessary to curb nitrate fertilizer application during the growing season. Also application of wastes on land should be confined to non-growing seasons to prevent ultimate ground-water nitrate pollution. (Russell-East Central)

## 1516-C1, C2, C3, D3, F1

### SEPTAGE: WASTES PUMPED FROM SEPTIC TANKS

Agricultural Engineering Department
Connecticut University
Storrs
J. J. Kolega, B. J. Cosenza, A. W. Dewey, and R. L. Leonard
Transactions of the ASAE, p. 1124-1127, 1972. 4 fig, 1 tab, 6 ref.

Descriptors: *Domestic wastes, *Septic tanks, *Sampling, Volume, Biochemical oxygen demand, Chemical oxygen demand, Physical properties, Chemical properties, Microbiology, Microorganisms, Costs, Bacteria, Hydrogen ion concentration, Odor, Color
Identifiers: *Septage, Concentration ratio

Septage disposal problems and feasible solutions vary among communities. Samples were taken from truck loads of septage brought to the Metropolitan District Commission, East Hartford, Connecticut Water Pollution Control Facility. Each sample collected was identified as to its purpose, i.e., bacteriological or physical—chemical. The following septage analyses were conducted: biochemical oxygen demand, chemical oxygen demand, pH, settleable solids, total solids, volatile solids, suspended solids, free ammonia, and organic nitrogen. Physical and visual observations were used for recording data on odor and color. Chemical and physical observations and results are discussed. When a state-wide septage disposal system is being planned or when a single disposal facility is being designed, septage volume estimates by area should be known. The costs per unit of volume for treating septage at a water pollution control facility are approximately 17 times the costs of treating sewage of the same volume. (Cameron-East Central)

## 1517-A1, A6, A10, B1, B4, E1, E2, E3, F1

### POULTRY WASTE MANAGEMENT ALTERNATIVES

North Carolina Agricultural Extension Service
L. B. Driggers, J. M. Falter, D. G. Harwood, G. J. Kriz, et. al.
North Carolina Agricultural Extension Service, Circular 570, September, 1973, 19 p. 1 fig, 11 tab.

Descriptors: *Poultry, *Farm wastes, *Waste treatment, *Waste storage, Waste disposal, Recycling, Drying, Economics, Pest Control, Water pollution, Soil contamination, Slurries, Lagoons, Effluent, Leaching, Nitrogen
Identifiers: Waste management, Odor control, Deep pit houses, Composting, Refeeding, Manure, Land application, Turkeys

This bulletin is designed to give waste management alternatives which will help the poultry producers meet their problems in the most practical and economical way. Producers or prospective producers who plan to renovate should look at the poultry production unit as a total system and should attempt to: (1) locate in the center of a large land tract if possible; (2) be sure that there is sufficient land available for waste disposal; (3) not locate the operation in a heavily populated area; (4) not locate the operation near drainage ditches, streams, rivers, and estuaries. The bulletin consists of five sections; alternative waste management systems, utilization and land requirements, odor control, pest control, and economics. Within the five sections the various systems of waste disposal are discussed, examples of how much waste can be applied per acre are given, suggestions are given for reducing odor and pest problems, and estimated cost data is presented. (Russell-East Central)

## 1518-A11, B1, C2, E3

### POULTRY MANURE AND MEAT MEAL AS A SOURCE OF DIETARY NITROGEN FOR SHEEP

Department of Animal Husbandry
Sydney University
Australia
J. Leibholz
Australian Journal of Experimental Agriculture and Animal Husbandry, Vol. 9, p. 509-593, December, 1969. 5 tab, 18 ref.

Descriptors: *Farm wastes, *Poultry, *Nitrogen, *Sheep, Amino acids, Energy, Performance, Waste disposal, Chemical analysis
Identifiers: Poultry manure, *Meat meal, Food conversion, Roughage, Australia, Weight gain

Because poultry manure has been found to be a potential source of nitrogen for ruminant animals, experiments were conducted to find suitable maintenance rations for sheep that were adequate in nitrogen and energy content. The experiments were designed to study the use of manure from caged layers as a source of nitrogen in low energy diets. Two experiments were conducted. In the first, sorghum was used as high energy source for the utilization of urea, while wheat was used in the second. Also in the second experiment hardwood sawdust was added. The experiments showed that poultry manure can be used satisfactorily as the main supplementary source of nitrogen when the sheep are fed a low protein, poor quality roughage. Results also indicated that 15% sawdust can be included in the diet of sheep without adversely affecting gain. (Russell-East Central)

## 1519-A2, C2

### NUTRIENT CONTENT OF BARNLOT RUNOFF WATER

U. S. Department of Agriculture
W. M. Edwards, E. C. Simpson and M. H. Frere
Journal of Environmental Quality, Vol. 1, No. 4, p. 401-405, October-December, 1972

Descriptors: *Nutrients, *Agricultural runoff, Feed lots, Farm wastes, Watershed, Nitrogen, Nitrates, Potassium, Phosphorus, Ohio, Water pollution, Sampling
Identifiers: Barnlot

Runoff from a beef cattle barnlot was analyzed to determine the concentration and transport of nitrate, total nitrogen, potassium, and phosphorus in the runoff water. The study was conducted from March, 1968 through December, 1970 and was conducted on a 60 head beef cattle barnlot. It was found that nitrate-nitrogen concentration was less than 2 mg/liter for eight months of the year with a concentration of 6 mg/liter as the highest peak. Soluble nitrogen was in a reduced form with a maximum monthly concentration of 70 mg/liter. Potassium concentration ranged 100-350 mg/liter, while phosphorus averaged less than 5 mg/liter during spring and summer with a peak of greater than 10 mg/liter in September. During the drier warm months nitrate concentration increased. All other measured elements decreased during this period when the barn was not in use. There appeared to be a high correlation between total nitrogen and temperature. (Russell-East Central)

## 1520-B2, B4, F1

### NEW CONCEPT CUTS COST FOR BEEF CONFINEMENT

Managing Editor
Farm Building News
D. Peach
Farm Building News, Vol. 7, No. 4, p. 1, 24-25, July-August, 1973, 6 fig.

Descriptors: *Confinement pens, *Cattle, *Costs, *Farm wastes, Economics, Waste treatment, Lagoons, Waste storage, Design
Identifiers: Beef, Flume and flush system

Plans for a beef confinement building with a new floor concept which may drastically cut the cost of the confinement feeding system have been developed by Iowa Beef Processors, Dakota City, Nebraska. The new concept eliminates the digging of a manure pit, the pit walls and floor, and the slats, replacing them with 2 inch slots and flumes under the concrete floor to catch the manure. The manure is then flushed to a lagoon. The estimated cost of such a system is about $70 per head capacity. The floor is sloped in the system to permit draining and the distance a feeder could flush manure is unlimited. The recommended confinement barn would vary from 24 to 40 ft. of cattle space, measuring from a feed bunk in one end to the other end. Further refinements are necessary, and experimentation is being conducted so that it is highly probable that confinement feeding can be accompanied for $70 per head or less in the near future. (Russell-East Central)

### 1521-A6, A9, B1, D2
### PILOT WASTE CONTROL AND ITS EFFECT ON POULTRY LITTER

Department of Poultry Science
Texas Agricultural Experiment Station
Texas A&M University System
College Station
W. F. Krueger, J. Bradley, and W. Milberger
Texas Agricultural Experiment Station Report, Department of Poultry Science, Texas A&M University, College Station, Texas, September, 1973, 8 p. 6 tab.

Descriptors: *Poultry, *Litter, *Farm wastes, Odor, Larvae, Larvicides, Waste treatment, Density, Quality control, Sampling, Air pollution
Identifiers: *Pilot Waste Control, Manure, Fly control, Chemical treatment

Odors and manure volume can be serious problems in cage layer and other types of poultry operations. Chemical treatment of manure may offer some relief to poultry operations with odor problems. A pilot study was initiated March 12, 1973, to evaluate Pilot Waste Control, a chemical with potential odor control properties. The objectives of the study were: to study the effect of chemical treatment of manure on odor; to determine the effect of litter treatment on manure density and quality; and to determine the number of treatments required to control odor and manure quality. When completed, recommendations were made. They were: (1) apply Pilot Waste Control to litter cones on a biweekly basis using the lowest recommended dilution rate; (2) add a larvacide to control fly larva; (3) use noncorrosive equipment when applying the chemical to litter; and (4) begin treatment when pullets are housed and continue through spring and early summer. (Russell-East Central)

### 1522-A11,B3,B5,C3,D3,E3
### THE EFFECT OF PROCESSING POULTRY MANURE ON DISEASE AGENTS

Texas A&M University, College Station.
J. R. Howes, C. F. Hall, and W. F. Krueger
EPA Research Report 670/2-73-041, July, 1973, 31 p. 3 fig. 12 tab, 8 ref.

Descriptors: *Poultry, *Diseases, *Farm wastes, waste treatment, waste disposal, recycling, fertilizers, fungicides, Salmonella, ultraviolet radiation, litter.
Identifiers: *Manure, *Processing, Recovery, Survival, Bacteriology, Shavings, Composts, Newcastle disease, Inoculation, Solid waste disposal.

*Manure, *Processing, Recovery, Survival, Bacteriology, Shavings, Composts, Newcastle disease, Inoculation, Solid waste disposal
Because poultry manure is an agricultural waste, methods of disposing and treating it must be found. The interrelationships between poultry manure processing, bacterial load, pathogenicity, and bird performance are poorly understood. In an attempt to deal with these problems, six experiments were conducted to compare the effects of various litter treatments on bird performance to eight weeks of age. To produce litter for broiler-type male chickens, the experimenters mixed poultry manure with other substances such as pine shavings, fresh sand, and cleaned rice hulls. Some of the mixtures were treated with a bacterial preparation. Comparisons were made of the treatments to see if the poultry manure could be incorporated into a mixture that would be beneficial to the chickens. The survival of disease agents in composted poultry waste was also investigated. Observations were recorded for each experiment. (Howes, Hall, and Krueger--Texas A&M University)

### 1523-A11, B3, D1, E2, F1
### NUTRIENT RECYCLING BY LAYING HENS

Department of Poultry Science
Texas A&M University
College Station
J. N. Quisenberry, and J. W. Bradley
Feedstuffs, Vol. 41, No. 5, p. 19, February 1, 1969, 7 tab, 1 ref.

Descriptors: *Recycling, *Nutrients, Waste treatment, Farm wastes, Waste disposal, Drying, Litter, Performance, Poultry, Feeds, Taste, Costs.
Identifiers: *Refeeding, *Laying hens

Today many approaches are being used to find satisfactory and economical solutions to the problems of waste management. It is generally conceded that for most poultry operations, waste management problems could be solved by concentrating on methods of obtaining dry droppings and litter. The dried product could then be used in a variety of ways. One such way is by recycling the poultry waste. The experiment conducted was designed to test the feasibility of poultry nutrient recycling by refeeding laying hens. Varying proportions of waste material were included in the diets of the hens. Careful records were kept, and effect on the taste of eggs was tested. The layers fared well on litter and mortality rate was no higher than on regular rations. Also, the taste of the eggs varied insignificantly. Not only was the litter of considerable economic value when recycled, but the return appears to be more than sufficient to bear the expense of drying. (Russell-East Central)

### 1524-A4,A5,A6,A10,A13,B3,F2
### SOLID MANURE HANDLING FOR LIVESTOCK HOUSING, FEEDING AND YARD FACILITIES IN WISCONSIN

E. G. Burns, and J. W. Crowley
Publication No. A2418, Cooperative Extension Programs, University of Wisconsin, Madison, November, 1972, 83 p. 50 fig. 17 tab.

Descriptors: *Solid wastes, *Livestock, *Facilities, *Wisconsin, Dairy industry, Legal aspects, Planning, Design, Waste storage, Farm wastes, Poultry, Equipment, Specifications
Identifiers: *Manure,* Waste management, *Housing, *Feeding, Land spreading, Fly control, Pollution, Formulas

These guidelines for solid manure storage systems are the results of discussions, suggestions and opinions by the Wisconsin Dairy Cattle Housing Committee. It was found that, as a general rule, manure should be returned to Agricultural land. Problems which must be controlled include pollution of surface or ground water, odor, insects, aesthetic offensiveness, and lower milk quality due to contamination by manure. Dairy farmers should obtain approval from their county zoning authority and have a detailed building and management plan before beginning construction of their facilities. Also, suggestions and guidelines for constructing waste handling systems are presented. Proper management maintenance and operation of the livestock facility and the manure handling system are essential. The suggestions for construction in these guidelines can meet requirements only if combined with good management. (Russell-East Central)

### 1525-B1, C1, C2, C3, D2
### THE USE OF VOLATILE FATTY ACIDS FOR THE CONTROL OF MICROORGANISMS IN PINE SAWDUST LITTER

Department of Poultry Science, North Carolina State University, Raleigh.
C. R. Parkhurst, P. B. Hamilton, and G. R. Baughman
Poultry Science, Vol. 53, No. 2, p. 801-806, March, 1974. 4 tab, 13 ref.

Descriptors: *Microorganisms, *Control, *Litter, Molds, Hydrogen ion concentration, Poultry, Performance, Temperature, Moisture content, Nitrogen, Sampling, Waste treatment
Identifiers: *Volatile fatty acids, *Pine sawdust, Acetic acid, Propionic acid.

Poultry men have for years used pine shavings as a litter for growing broilers, but shavings are becoming hard to get and expensive. Pine sawdust is more readily available, but it has a history of increased disease and management problems. This study investigated the use of volatile fatty acids in the sawdust for the control of microorganisms. Acetic acid (60%) and propionic acid (40%) were mixed into fresh pine sawdust at 1% and 3% levels. Broilers were placed on the litter when one day old and reared to eight weeks of age. At eight weeks there appeared to be no significant effect on mean body weight, feed conversion efficiency, or mortality. The moisture content, final nitrogen content, and litter temperature were also unaffected by the treatments. Mold growth was retarded slightly at the 3% level for the first two weeks, and bacterial count was retarded for at least a week. The pH was reduced significantly from the control for three weeks at the 3% level and for two weeks at the 1% level. The findings suggest that pine sawdust would serve adequately as a litter material. (Russell-East Central)

### 1526-B2, C2, D2, E3
### SOME CHEMICAL AND PHYSICAL ASPECTS OF PHOSPHATE PRECIPITATION FROM ANAEROBIC LIQUORS DERIVED FROM ANIMAL WASTE TREATMENT LAGOONS

Agricultural Engineering Department
Iowa State University, Ames
C. V. Booram, R. J. Smith, and T. E. Hazen.
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, Paper No. 73-4522, 17 p. 6 fig, 2 tab, 12 ref.

Descriptors: *Chemical properties, *Physical properties, *Phosphates, *Farm wastes, Waste treatment, *Pipe flow, Lagoons, Anaerobic conditions, Irrigation, Waste disposal, Sludge, Equipment
Identifiers: *Precipitation, Minerals

To be effective, all phases of a waste management system must function efficiently. It has been found that recycling anaerobic lagoon liquid to transport manure from swine confinement pens has resulted in magnesium ammonium phosphate buildup in metal pipes. This leaves two alternatives: (1) converting to aerobic systems to oxidize ammonia or (2) developing equipment to overcome the buildup problem. Study indicates that overcoming this problem could best be accomplished by developing equipment. The buildup is a result of the metal interface which exists in the pipes. Therefore, plastic should be used in all plumbing. Some buildup will take place in plastic, but an acetic acid solution should periodically be added to control encrustation. Also irrigation equipment used to apply lagoon effluent to land will pass a lot less liquid per year than recycle equipment and will have less of a buildup problem. (Russell-East Central).

### 1527-B2, C2
### NUTRIENT REDUCTION TO WASTE-WATER BY GRASS FILTRATION

Department of Agricultural Engineering
The Pennsylvania University
University Park.
R. M. Butler, E. A. Myers, J. N. Walter, and J. V. Husted
Presented at the 1974 Annual Meeting of American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 12 p. 3 fig, 3 tab, 6 ref.

Descriptors: *Nutrients, *Waste water treatment, *Filtration, *Nitrates, Nitrogen, *Phosphorus, Municipal wastes.
Identifiers: *Grass filtration

Study was undertaken to determine the effects of flow rate, flow distance, application frequency, and seasonal changes on nitrate and phosphate removal for a grass filtration wastewater renovation system. Renovation was greatest with the lowest application rate and longest flow distance, as expected. Increasing application frequency reduced removal efficiency in both phosphates and nitrates. Laboratory and field studies were undertaken. In the field study no significant reduction in nitrates or phosphates were observed. The laboratory studies indicated that much longer contact times were necessary to obtain adequate nitrate renovation than were employed in the field studies. The labortory studies also developed a relationship between nitrate concentration, contact time, and temperature that can be used to estimate the detention time required for nitrate removal in grass filtration systems. (Russell-East Central).

## 1528-A2, B1, C2

### CATTLE FEEDLOT HYDROLOGY

Agricultural Engineering Department
Oklahoma State University
Stillwater
A. F. Butchbaker
Presented at Oklahoma Section, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, October 20, 1972, 25 p. 7 fig, 10 tab, 14 ref.

Descriptors: *Feed lots, *Cattle, *Hydrology, *Farm wastes, *Runoff, Precipitation (Atmospheric), Design, Great Plains, Pollutants, Nitrogen, Phosphorus, Chemical oxygen demand
Identifiers: Runoff control, Cattle density, Total solids

Many characteristics affect runoff from feedlots, and knowledge of feedlot hydrology is necessary to design runoff control facilities for feedlots. Runoff is variable from feedlot to feedlot, but certaian trends are evident in feedlot hydrology. Evidence was gathered from research that was conducted in the southern Great Plains area. It was discovered that approximately the first one-half inch of rainfall is stored on the feedlot surface with the rest as potential runoff. The annual runoff of most feedlots is forty to fifty percent of the annual rainfall. Research also found pollutional characteristics and solid transport characteristics of feedlot runoff. Much more research is necessary for the complete picture of runoff, but the present available information should be useful in the design of runoff control facilities and the management of disposal areas. (Russell-East Central),

## 1529-A11,B3,C1,C2,D1,E3

### DRIED ANIMAL WASTE AS A PROTEIN SUPPLEMENT FOR SHEEP

Michigan State University
East Lansing
P. Tinnimit, Yu Yu, K. McGuffey, and J. W. Thomas
Journal of Animal Science, Vol. 35, No. 2, p. 431-435, 1972. 7 tab, 12 ref,

Descriptors: *Farm wastes, *Recycling, *Sheep, Organic matter, Carbohydrates, Diets, Feeds, Performance
Identifiers: *Dried animal wastes, *Refeeding, *Protein supplement, Rations, Digestibility.

Analysis that indicates that 12-40% protein and 40-70% carbohydrates are possibly contained in animal feces prompted this study to obtain information on the value of the feces to supply nitrogen, dry matter, and organic matter to sheep. Four trials were undertaken with excellent results. Sheep were fed feces as 20-80% of a mixed ration. The dehydrated feces furnished from 40 to over 90% of the total nitrogen. Digestibility of this nitrogen was 44-62 percent. The sheep were fed about 11% protein with from 18-72% retention of digested nitrogen as compared to 16-65% retention for soybean meal rations. Dry and organic matter digestibility of 53 and 64%, respectively, were found for dehydrated caged layer feces. Dry and organic matter digestibilities of 58% and 69%, respectively, were found for cattle, swine, and poultry feces plus corn or corn starch, corn cobs, molasses, and minerals. Trials show that dehydrated animal feces can indeed be incorporated into the rations of ruminants with promising results. (Russell-East Central)

## 1530-A5, A8, B1, C2, E2

### AMMONIUM, NITRATE, AND TOTAL NITROGEN IN THE SOIL WATER OF FEEDLOT AND FIELD SOIL PROFILES

Northern Plains Branch, Soil & Water
Conservation Research
Division, Agricultural Research Service
U. S. Department of Agriculture
Lincoln, Nebraska
L. F. Elliott, T. M. McCalla, L. N. Mielke, T. A, Travis
Applied Microbiology, Vol. 28, No. 4, p. 810-813, April, 1972, 1 fig, 4 tab, 11 ref.

Descriptors: *Nitrates, *Feed lots, *Soil profiles, *Soil water, *Groundwater pollution, Sampling, Aquifers, Cattle, Farm wastes
Identifiers: *Ammonium, *Total nitrogen, Fields, Mounding

Much concern has been generated in the area of possible movement of nitrogen compounds from feedlot surfaces to groundwater. With so many high density feeding operations underway today, the fear that possible groundwater pollution may occur has prompted many investigations on a level feedlot on Wann silt loam above sand. Soil water samples were taken at 46, 76, and 107 cm beneath the surface. Results of samples indicated that the feedlot contributed no more nitrate-nitrogen or ammonia-nitrogen than did an adjacent cropped field. Nitrate-nitrogen levels in soil water samples were less than 1 mg/ml. During the summer nitrate-nitrogen increased at the 15 cm depth which indicates that nitrification took place at the surface of the feedlot. However, nitrate-nitrogen levels below the 15 cm depth indicates that dentrification took place beneath the surface. (Russell-East Central)

## 1531-B2, B3, B4, E1, E2

### MANURE AND WASTE PROJECTS ON DAIRY FARMS

Agricultural Engineering Department
College of Agricultural and Life Sciences
Wisconsin University
Madison
L. A. Brooks, and T. J. Brevik
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, Paper No. 73-5543, 14 p. 23 fig.

Descriptors: *Farm wastes, *Cattle, *Dairy industry, Lagoons, Waste disposal, Design, Wisconsin, Waste storage, Experimental farms
Identifiers: *Manure, Milking parlor wastes

Many waste management problems are currently facing Wisconsin dairy farmers. Over 90% of the dairy farms in Wisconsin have less than 50 cows, and this fact prevents installation of elaborate and expensive waste disposal systems. What is needed is a low cost, but effective, means of handling dairy waste. In coordination with the University of Wisconsin, three low cost solid manure storage facilities were installed on private farms. The storage areas vary in size and construction, and each site cost $1,000 or less. From these projects, it is hoped, will come some of the answers to waste management. Another area of concern is milking parlor waste disposal. Most farmers use a conventional septic tank disposal system for discharging parlor wastes, but this hasn't proved to be effective. In 1972, University of Wisconsin Agricultural Engineers designed experimental disposal methods to be employed on private farms. Three farms installed disposal lagoons; two farms installed ridge and furrow disposal systems; and two shallow disposal beds were installed on another farm. Data obtained from these facilities during the next few years will determine their usefulness for waste management. (Russell-East Central)

## 1532-B2, C1, C2, D1, D3

### SALMONID HATCHERY WASTEWATER TREATMENT

Consultant for Kramer, Chin, & Mayo Consulting Engineers
Seattle, Washington.
P. B. Liao
Water & Sewage Works, Vol. 117, p. 439-443, August, 1970. 2 fig, 3 tab, 4 ref.

Descriptors: *Salmonids, *Waste water treatment, *Oxidation lagoons, *Aeration, *Fish hatcheries, Sedimentation, Pollution, Odor, Detention, Effluent, Oxygen, Nitrates, Phosphates, Filters, Biochemical oxygen demand, Water pollution, Effluents
Identifiers: *Primary settlings, Imhoff cone raceway cleaning wastes

Paul Liao recently discussed the nature of salmonid hatchery wastes and their pollution potential. The treatment methods studied for such hatchery wastes were stabilization ponds, primary settling, and aeration. In this paper, each of these methods is discussed. The results of this study show that a stabilization pond can provide BOD and suspended solids reduction on the order of 60% or more BOD loading rates of 50 lb./acre-day with detention time of about three days. Sedimentation ponds providing in excess of two hour detention time can be expected to reduce the BOD and solids removal from the effluent of raceways being cleaned by about 80%. A combination of short term aeration (an air supply rate ranging from 0.15 to 0.25 cu. ft./gal.) and an adequate detention time with (4 to 10 hr.) can reduce hatchery pollution loads by 50 to 90%. (Cameron-East Central)

## 1533-A11, B3, E3, F1

### DEHYDRATED POULTRY WASTE AS A FEED FOR MILKING COWS AND GROWING SHEEP

Department of Dairy Science
Michigan State University
East Lansing
J. W. Thomas, Yu Yu, P. Tinnimitt, and H. C. Zindel
Journal of Dairy Science, Vol. 55, No. 9, p. 1261-1265, 1972. 4 tab, 8 ref.

Descriptors: *Farm wastes, *Poultry, *Feeds, *Cattle, Sheep, Dairy industry, Waste disposal, Recycling, Diets, Performance
Identifiers: Dehydrated poultry wastes, Refeeding

Milking cows and fattening sheep were fed dehydrated feces from caged layers to determine its value as a feed and protein source. The milking cows were fed manure that would provide for 23% of the total dietary protein and 11% of the total dry matter. The sheep were fed manure to provide for 61 or 90% of total protein and 25 or 50% of total feed. The cows fed this ration produced equal amounts of milk as those fed a normal ration. Sheep gained less when fed the feces than they did when fed the normal ration. However, carcass grade of the sheep fed 25% feces was equal to those fed normally. The main advantage favoring feces is the cost. Dehydrated manure costs only $20 per 908 kg. The results show that it is feasible and economical to use manure as a feed ingredient and energy source for cows and lambs. (Russell-East Central)

## 1534-A11, C2, E3, F1

### SHORTCOMINGS AS FEED INGREDIENT

Department of Poultry Science
New York State College of Agriculture
Cornell University
Ithaca, New York
M. C. Scott
Egg Industry, Vol. 6, No. 7, p. 36, 38, 1973. 1 fig, 1 tab, 6 ref.

Descriptors: *Feeds, *Proteins, *Farm wastes, *Poultry, Dehydration, Recycling, Waste treatment, Waste disposal, Performance, Amino acids, Ammonia, Nitrogen, Phosphorus
Identifiers: *Dried poultry wastes, *Manure, Refeeding

There has long been a question about the true value of poultry waste as a protein supplement. Research has found that most of the nitrogen in pure poultry manure is not protein at all, but is a product of metabolism such as uric acid, ammonia salts, creatine, creatinine, etc. Nesheim reports that the actual protein content of poultry manure is only about 10.8% and not 30-35% as previously assumed. Young and Nesheim have found that the maximum amount of poultry waste that can be fed to poultry without affecting egg production is about 22 percent. This, in turn, would result in extra manure which must be dealt with by other waste management systems and would amount to about 75 to 80% of the total manure produced by the hens. Calculations indicate that the value of the manure is no greater than $26 per ton. Also, when fed back to poultry, the manure is not a good source of protein and is a poor source of energy. (Russell-East Central)

### 1535-A5, A8, B1
### SOIL PROFILE CONDITIONS OF CATTLE FEEDLOTS

U. S. Department of Agriculture
Lincoln, Nebraska
L. N. Mielke, N. P. Swanson, and T. M. McCalla
Journal of Environmental Quality, Vol. 3, No. 1, p. 14-17, 1974. 4 fig, 2 tab, 5 ref.

Descriptors: *Soil profile, *Feed lots, *Cattle, *Farm wastes, Soils, Water pollution, Soil contamination, Organic matter, Infiltration
Identifiers: *Feedlot surfaces, *Layered soils, Interface layer

Before one can assimilate the potentials for soil and water pollution he must know the conditions and characteristics of the soil. Feedlot surfaces are unique in that the packed layer of organic matter behaves differently than other soils. The profile of feedlot soils can be described as three layers: the organic matter, the interface, and the underlying soil. The profile of the underlying soil of a feedlot has little effect on water movement into the profile or on runoff. The bulk density at the interface layer is greater in a feedlot than in cropland at the same depth. Water movement is impeded because of the compactness and effects on soil particle dispersion. The surface layer of a feedlot may absorb large amounts of water into the soil, but actual infiltration of water into the soil is minimal. When manure is present and covering an interface, nitrate-nitrogen is less likely to accumulate in the profile. (Russell-East Central)

### 1536-A8, C2
### THE COMPOSITION OF THE SOIL ATMOSPHERE BENEATH A BEEF CATTLE FEEDLOT AND A CROPPED FIELD

U. S. Department of Agriculture
Lincoln, Nebraska
L. F. Elliott, and T. M. McCalla
Soil Science Society of America Proceedings, Vol. 36, p. 68-70, 1972. 1 fig, 5 tab, 13 ref.

Descriptors: *Feed lots, *Cattle, *Soils, *Ground water pollution, Gases, Denitrification, Sampling, Soil profiles, Methane, Carbon dioxide, Oxygen, Nitrogen
Identifiers: Composition, Cropped field

The purpose of this study was to measure the soil gases beneath a level feedlot and a cropped field. The shallow water table beneath the feedlot had revealed NO3-N concentrations above 10/ppm only twice in a 3 year period. The soil gases beneath the feedlot were measured to discover why the feedlot was not contaminating the groundwater with NO3-N. The data revealed that the feedlot soil profile was reduced, contained organic matter, and was favorable for denitrification, at least at times during the year. The high CH4 values recorded, when precipitation was received and moderate temperature prevailed, showed anaerobic conditions. Soil core studies in the feedlot revealed low Eh values. While 02 levels increased when the feedlot was dry or frozen, significant downward movement would not be expected under these conditions, so no mechanism existed for NO3-N transport to the water table. The data also showed the feedlot soil profile to be favorable for denitrification when downward water movement would be expected. Gas data was given in detail and provided a possible explanation as to why little NO3-N reached the water table. (Cartmell-East Central)

### 1537-A6, B2, B4, C2, D3
### THE EFFECTS OF LIMITED AERATION ON THE ODORS OF LIQUID DAIRY MANURE

K. D. Vickers
Unpublished M. S. Thesis, University of Idaho, 1972, 67 p. 13 fig, 7 tab, 24 ref.

Descriptors: *Aeration, *Odor, *Liquid wastes, *Farm wastes, *Dairy industry, *Slurries, Chemical oxygen demand, Amino acids, Sampling, Hydrogen ion concentration, Ammonia, Nutrients

This study was undertaken to determine the best aeration volume that would reduce odors in liquid dairy manure storage pits without losing nutrient value in the slurry. Tests began using the volume of air that would reduce the Chemical Oxygen Demand by 10% at an 8% oxygen transfer efficiency. Two runs were then made using substantial air volume reductions. A fourth run was made without any aeration. As the aeration volume was reduced the odor increased. There was no nutrient loss during any of the experiments during which air was supplied to the manure slurry. During the experiments the manure slurry was monitored for oxidation reduction potential, drainability, ammonia, Kjeldahl nitrogen, volatile acids, oxygen, methane, pH, odor value, COD, total and volatile solids, and total phosphorus. (Russell-East Central)

### 1538-A11, B1, B5, C2
### INFLUENCE OF THE CONCENTRATION AND VOLUME OF SALINE WATER ON THE FOOD INTAKE OF SHEEP, AND ON THEIR EXCRETION OF SODIUM AND WATER IN URINE AND FAECES

Rangelands Research Unit
CSIRO, Riverina Laboratory
Private Bag, P. O.
Deniliquin, N.S.W. 2710
A. D. Wilson and M. L. Dudzinski
Australian Journal of Agricultural Research, Vol. 24, No. 2, p. 245-256, 1973. 8 fig, 1 tab, 12 ref.

Descriptors: *Sheep, *Saline water, *Farm wastes, Sodium, Water, Urine, Diet, Salts, Potassium, Sodium chloride, Moisture content
Identifiers: *Excretion, *Feces, Food intake, Salt tolerance

Merino sheep were given fixed volumes of fresh and saline drinking water. The volumes varied from 0.5 to 6.0 liter per day, and salt content ranged from 1.5 to 2.0% sodium chloride. The intake of food and the excretion of urine and feces were then recorded. It was found that food intakes increased with an increase in either fresh or saline water. When sodium chloride was added to the water the food intake decreased but was restored by an increase in the volume of water given of C. 50% for 1.5% salt, and C. 100% for 2.0% salt. When sheep were given saline water the sodium content of the urine increased, but the sodium content of the faeces remained the same. The volume of urine excreted was related to the amount of sodium and potassium to be excreted, but the amount of water excreted in the faeces was related to the type of diet and the amount of faecal dry matter excreted. (Russell-East Central)

### 1539-A1, B1, E1, E2, F2
### SLURRY AND WASTE DISPOSAL

19 The Crescent
Taunton, Somerset
Great Britain
D. Gowan
Suffolk, England, Farming Press Limited, 1972, 244 p, 44 fig, 37 tab, 12 ref.

Descriptors: *Slurries, *Farm wastes, *Waste disposal, *Legal aspects, Soils, Economics, Water pollution, Sampling, Poultry, Lagoons, Hogs, Waste treatment, Aeration, Equipment, Odor, Diseases, Cattle, Waste storage, Fertilizers
Identifiers: *Great Britain, Land disposal, Pollution, Public health

Many problems face farmers today, and this book examines problems in the area of animal and agricultural discharges. There is a technical discussion of the problems of waste disposal, and the special problems of different forms of effluent are discussed. A substantial part of the book deals with the legality of discharges in the area of Statutory Law and Common Law. This British author also discusses poultry, swine, and cattle waste disposal problems. The final sections of the book bring out effects of these discharges on the soil, current research in the area of waste disposal, and prospects concerning the future problems of the agricultural industry in the United Kingdom. The overall view point of the book is that it is time for farmers to get their heads out of the sand and start working to solve these waste disposal problems. (Russell-East Central)

### 1540-A2, A4, A5, A8
### WATER SOLUBLE ORGANIC SUBSTANCES LEACHABLE FROM FEEDLOT MANURE

U. S. Department of Agriculture
Ft. Collins, Colorado
A. R. Mosier, K. Haider, and F. E. Clark
Journal of Environmental Quality, Vol. 1, No. 3, p. 320-323, July-September, 1972. 3 tab, 17 ref.

Descriptors: *Feedlots, *Farm wastes, *Leachate, *Organic matter, Sampling, Runoff, Soil profile, Groundwater pollution, Phenols, Nitrogen, Wells, *Manure

Little is known about the fate of the water-soluble organic products of animal excretion once they enter the soil. Because of this many water samples were taken from feedlots, shallow wells near feedlots, a local river, and soil from a grassland to see if organic materials were readily dispersed from feedlot surfaces. The organic materials readily move on the ground surface due to runoff, but in soil beneath the feedlot or in soil away from the feedlot only free phenolics were found to have leached. Only trace amounts of low-molecular-weight organics were found in ground water samples. From the results, it was concluded that there is no uniform or continuing movement of organic material from the feedlot surface through the soil profile to the ground water under the sites examined. (Russell-East Central)

### 1541-B1, D1, E2, E3, F1
### SOLIDS-LIQUID SEPARATION—AN IMPORTANT STEP IN THE RECYCLING OF DAIRY COW WASTES

Department of Agricultural Engineering
Purdue University
Lafayette, Indiana 47807
Journal of Milk & Food Technology, Vol. 36, No.
A. C. Dale
5, p. 289-295, 1973. 2 tab, 15 ref.

Descriptors: *Recycling, *Farm wastes, *Cattle, *Dairy industry, Biochemical oxygen demand, Economics, Waste treatment, Waste disposal,

Biodegradation, Drying, Equipment, Composting, Methane, Proteins, Oil
Identifiers: Solids-liquid separation, Refeeding, Land disposal, Building blocks.

For years dairy farmers have looked for a waste management system which would lower labor requirements, make mechanical handling possible, improve automation, lower pollution, and produce something of economic value. Solids-liquid separation may be the answer to the complex and expensive problem of waste disposal. In solids-liquid separation, particles 5/u or larger are removed from the liquid part of the waste. The two fractions left are wet solids and a dilute liquid. The solids contain about 45-80% water. They have little or no odor and may be dried and used for refeeding, mulch, or bedding, thus giving it economic value. The liquid fraction contains about 1-3% suspended solids and about 85-90% of the five-day Biological Oxygen Demand. The liquid can be easily handled by ordinary equipment and can be irrigated directly onto crops and soils, (Russell-East Central)

### 1542-A6, C2, D3
### DETECTION OF CARBONYL SULFIDE FROM BEEF CATTLE MANURE

U. S. Department of Agriculture
Lincoln, Nebraska
L. F. Elliott, and T. A. Travis
Soil Science Society of America Proceedings, Vol. 37, No. 5, p. 700-702, Sept./Oct., 1973. 1 tab, 5 fig, 8 ref.

Descriptors: *Feed lots, *Cattle, *Odor, *Gases, *Farm wastes, Hydrogen sulfide, Methane, Carbon monoxide
Identifiers: *Odor detection, *Carbonyl sulfide, *Manure

Before odors and gases can be controlled they must be identified and their intensity and quantity must be determined. Basic research was conducted to identify and quantify some of the sulfur compounds and gases emanating from anaerobically incubated cattle manure. One compound identified was carbonyl sulfide. It was found in the headspace above fresh manure, feedlot compost, a debris basin, and soil from a feedlot. Carbonyl sulfide became progressively stronger from day 1 to 5 and then declined. Hydrogen sulfide was similar and persisted for 16 days. Methane was also found and never exceeded 7,5% over fresh manure. In the headspace over compost, methane exceeded 36%, hydrogen sulfide appeared after 5 days, and only traces of carbonyl sulfide appeared. (Russell-East Central)

### 1543-A2, B2, B4, E2, F6
### PERFORMANCE OF FEEDLOT RUNOFF CONTROL SYSTEMS IN MINNESOTA

Department of Agricultural Engineering, Minnesota University, St. Paul.
C. L. Larson, L. G. James, P. R. Goodrich, and J. A. Bosch.
Presented at the 1974 Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4013, 17 p. 3 fig., 4 tab, 9 ref.

Descriptors: *Performance, *Feed lots, *Runoff, *Minnesota, Waste storage, Waste disposal, Irrigation, Precipitation (Atmospheric), Mathematical models, Slopes, Climatic data, Farm wastes,
Identifiers: Runoff control systems, *Holding pond, Land disposal, Formula.
Livestock.

Feedlots located on sites with a considerable slope are potential pollutors from runoff. Runoff is generally controlled by involving a holding pond with land disposal of the stored water. A mathematical model was constructed to determine factors influencing runoff control. Results indicate that in Minnesota, holding pond outflow is caused by a series of rainstorms occurring within a period of five to ten days. This is because disposal of stored runoff is seldom possible during these times. If the holding pond is designed on the one-day rainfall and runoff data, it should be increased by factor C to obtain an overflow frequency. However, if the holding pond is made larger than necessary, the amount of land disposal can be reduced. For efficient operation of a runoff control system, the holding pond capacity should be equal to the sum of three components: the design runoff, the minimum pumpout, and the residual storage. (Russell-East Central).

### 1544-A4, A6, A7, F2
### SUPREME COURT UPHOLDS JUDGEMENTS IN HBI CASE

L. Harper.
Missouri Ruralist, January 23, 1971, p. 12.

Descriptors: *Air pollution, *Legal aspects, *Odor, *Water pollution, *Confinement pens, Hogs.
Identifiers: *Supreme court, *Judgement, *Plaintiffs.

Reported is the results of a long term legal battle between Hog Buliders, Inc. and Glen and Doris Bower and Frank and Minnie Bower. The suit was filed in 1969 by the Bowers who contended that HBI had been negligent in their pollution control, had devalued the Bowers' land, and had impaired their living. The suit was heard by a jury and the jury found HBI guilty of both actual and punitive damages. The Bowers were awarded $136,200 by the jury. The case was then appealed to the Missouri Supreme Court, but the court held with the jury. HBI awarded the Bowers $136,200 and sold the hogs. The facilities were empty for several months until HBI sold the land. This case has caused many feeders to take extra precautions, and it is hoped that this case does not lead to many more law suits. (Russell-East Central).

### 1545-A10,A11,B1,E2,F1,F2
### THE PLUS AND MINUS OF CONFINEMENT

Feedlot Management, Vol. 15, No. 13, p. 25-27, 30, 32, 46, December, 1973. 5 fig.

Descriptors: *Confinement pens, *Cattle, *Feed lots, Farm wastes, Waste treatment, Waste disposal, Fertilizers, Performance.
Identifiers: *Confinement buildings, Land spreading, Holding tank, Slotted floors, Open feed lots.

Confinement feeding is currently one of the major methods of maintaining an efficient feedlot operation. One such confinement feeder is Ray Lawson of Maple Park, Illinois. His cold-air confinement building has served for two years and promises to enhance the operation for years to come. The cost of a confinement feedlot operation is about $110 per animal unit. The waste system consists of a holding tank beneath the slotted floor in the confinement facility. The wastes are then spread on land and the value of the feritlizer is estimated at about $35 per acre. Trials conducted on an uninsulated confinement facility and an open lot feedlot have indicated that the performance of feedlot cattle in an uninsulated confinement building is inferior to that of cattle fed in open lots with access to overhead shelter. However, construction of a confinement building can be justified because there is elimination of bedding costs, pollution control, mechanization, the substitution of capital for labor, less land area required, cleanliness of cattle, better control over flies, and the possibility of fewer health problems in a confinement operation as compared to an open feedlot. (Russell-East Central),

### 1546-A1,B1,D1,E1,F1,F4
### SWINE WASTE MANAGEMENT ALTERNATIVES

L. B. Driggers, J. M. Falter, J. R. Jones, G. J. Kriz, J. F. Lutz, et. al.
Cooperative Extension Work in Agriculture and Home Economics, North Carolina State University, Raleigh and USDA Cooperating. 24 p. 1 fig., 9 tab

Descriptors: *Hogs, *Farm wastes, *Waste treatment, *Waste disposal, *Waste storage, Lagoons, Drying, Odor, Pest control, Economics, Soils, Nutrients, Rates of application, Crops, Effluent, Storage tanks, Chemical properties, Physical properties, Leaching, Runoff, Slurries, Costs.
Identifiers: *Swine, *Waste management, Land spreading, Composting, Mechanical aeration, Flies.

Swine production is becoming a more specialized and complex operation. This bulletin is designed to help swine producers meet problems in the most practical and economical way. Alternative waste management systems, utilization and land requirements, odor control, pest control, and economics are discussed. The section on utilization and land requirements presents guidelines and examples of the amount of waste that can be applied per acre. The sections on odor and pest control provide suggestions and methods for reducing odor and pest problems. The section on economics gives estimated cost data and contains a partial budget sheet so that comparisons between the alternative waste management systems can easily be made. No matter what means of waste management system is chosen, good management is necessary to maintain an effective operation. (Russell-East Central).

### 1547-A6, B2, B4, C2
### IDENTIFYING ODOROUS COMPONENTS OF STORED DAIRY MANURE

Department of Agricultural Engineering, Clemson University, Clemson, South Carolina.
C. L. Barth, and L. B. Polkowski.
Presented at 1971 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 7-10, 1971, Paper No, 71-568, 27 p., 6 fig.

Descriptors: *Odor, *Farm wastes, *Waste storage, *Dairy industry, Cattle, Liquid wastes, Sampling, Sludge, Ammonia, Chromatography.
Identifiers: *Manure, *Selective absorption, *Steam distillation, *Paper chromatography, *Odorants, Identification, Supernatant.

The biggest problem that livestock producers face is odor management. Livestock producers generally either try to eliminate the initial production of the odorous components or control the odorous material after it is produced. Before effective odor control can be achieved the odorous compounds must be identified, Processes used in this experiment designed to identify odorous compounds were selective absorption, steam distillation, and paper chromatopgraphy. Selective absorption separated volatile organic acids, amines, ammonia, hydrogen sulfide, mercaptans, and disulfides for further identification. Steam distillation distinguished ammonia and total volatile organic acids. Paper chromatography proved to be a practical tool in identification of odorous compounds. The odorous compounds identified were: acetic, propionic, butyric, and valeric acids; methyl-, dimethyl-, ethyl-, and diethylamine; ammonia, hydrogen sulfide, mercaptans, and disulfides. (Russell-East Central).

### 1548-A8, B1, 12, E2
### MANURE APPLICATION GUIDELINES FOR THE PACIFIC NORTHWEST

Agricultural Engineering Department, Oregon State University, Corvallis.
T. L. Willrich, D. O. Turner, and V. V. Volk.
Presented at the 1974 Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4061, 12 p., 5 tab, 2 ref.

Descriptors: *Pacific Northwest U. S., *Farm wastes, *Waste disposal, *Equations, Nitrates, Fertilizers, Nitrogen, Leaching, Livestock, Waste storage, Lagoons, Irrigation, Volatility,
Idenitfiers: *Manure, *Application rates, *Land spreading.

Most farmers who apply manure to land know very little about how much to apply. Research must supply the answers before ground water supplies are polluted. Generally nitrogen is the limiting factor in manure application because it readily moves in the soil whereas phosphorous and potassium are more static. Accurate rational equations must be developed to estimate: (1) the amount of nitrogen which should be added to the soil to maximize crop yields and to satisfy the normal losses of nitrogen from the soil and the losses that occur when manure nitrogen is substituted for synthetic nitrogen, and (2) the amount of residual manure nitrogen which remains for soil incorporation after the subtracting all losses which occur before soil incorporation. Equations are presented, but future modifications and refinements are essential to correct weaknesses and errors which currently exist. (Russell-East Central).

### 1549-A6,A11,C1,C2,E3,F2
### RECYCLING ANIMAL WASTES. 1. THE PROBLEMS OF DISPOSAL AND REGULATORY ASPECTS OF RECYCLED MANURES
Nutrition Section, Agricultural Research Council, Poultry Research Center, West Mains Road, Edinburgh EH9 3JS, Scotland.
R. Blair, and D. Knight.
Feedstuffs, Vol. 45, p. 32, 34, March, 1973. 3 tab.

Descriptors: *Recycling, *Farm wastes, *Waste disposal, *Legal aspects, Drying, Odor, Microorganisms, Moisture, Nitrogen, Feeds, Sampling, Diseases.
Identifiers: Animal wastes, *Great Britain, *Manure, Pollution, Refeeding, Feed additives, Drugs.

Since feeding operations are becoming more intensified there is no longer enough land on which to spread manure. Recycling or feeding of manure to farm animals is one possible means of disposing this by-product of modern day feeding. This paper reports on preparation of manure for feeding and on the regulatory aspects of recycling. Probably the most important aspect of preparing manure is drying it. For commercial purposes, Quality Control Standards suggest that poultry manure should have less than 15% moisture, not less than 5% nitrogen, and good appearance with little odor. If it is being incorporated into feed, it should list any drugs or additives and good hygiene should be practiced. Regulations look unfavorably on recycling manure because it may contain drugs, antibiotics, or disease organisms. However, when dried poultry manure has been properly processed, it appears to present no serious health dangers when fed to ruminants. Further research is necessary before the Food and Drug Administration will approve use of manure in feeds. (Russell-East Central).

### 1550-B5, C3
### A QUANTITATIVE COMPARISON OF THE FAECAL MICROFLORA OF BABOONS FED A NATURAL DIET OR A SYNTHETIC DIET COMPLETE OR DEFICIENT IN PYRIDOXINE OR RIBOFLAVIN
Wellcome Trust Research Laboratories, P.O. Box 43640, Nairobie, Kenya.
P. F. Uphill.
The Journal of Applied Bacteriology, Vol. 36, No. 3, p. 501-511, September, 1973. 2 tab, 42 ref.

Descriptors: *Diets, *Microorganisms, Sampling.
Identifiers: *Animal wastes, *Baboons, Faecal microflora, Pyridoxine, Riboflavin

A group of baboons were fed a natural diet of fruit and vegetables while three other groups of baboons were fed a synthetic diet which either included pyridoxine and riboflavin or was deficient in both. Quantitative analysis was then made of the baboon faecal material to study its microflora. There appeared to be no significant difference in the microbial counts of baboons fed diets deficient in pyridoxine and riboflavin and baboons on natural diets. The groups fed the synthetic diet had increases in Clostridium welchii and lactose-fermenting enterobacteria with a decrease in lactobacilli. There was a slight reduction of yeasts and a slight increase of microccocci, staphylococci, and faecal strepococci. When the groups were first fed the synthetic diet there was a marked change in microflora which was very stable. When the groups were then fed a natural diet, another marked change in microflora occurred. (Russell-East Central).

### 1551-A2, A3, B1, F6
### PROJECTS OF THE AGRICULTURAL AND MARINE POLLUTION CONTROL SECTION
Applied Science and Technology Branch, Office of Research and Monitoring, Environmental Protection Agency, Washington, D. C. 20460.
K. Jacobson and W. J, Lacy.
Environmental Protection Agency Research Report EPA-R2-73-171, March, 1973, 201 p.

Descriptors: *Agriculture, *Projects, *Farm wastes, *Research and development, Forestry, Agricultural runoff, Feed lots, Recreation, Oil spills.
Identifiers: *Marine pollution, Logging, Irrigation return flow, Watercraft wastes, Hazardous material spills.

Projects of the Agricultural and Marine Pollution Control Program—March 1973 is a compilation of the information sheets of the 160 projects initiated from fiscal year 1972. Each sheet contains the objectives, statistical information and a brief description of an initiated project. General introductory information on the Environmental Protection Agency's Agricultural and Marine Pollution Control Program is also presented to provide perspective on the magnitude of these non-point pollution problems and the research direction that must be pursued in order to develop the technology to adequately control non-point sources in the United States. (Jakobson and Lacy-EPA).

### 1552-A1, A4, A6, F2
### PHILOSOPHY ON LIVESTOCK WASTE REGULATION
Missouri University, Columbia.
D. R. Levi.
Presented at 1971 Winter Meeting of the American Society of Agricultural Engineers, Chicago, Illinois, December 7-10, 1971, Paper No. 71-918, 10 p.

Descriptors: *Farm wastes, *Livestock, *Regulation, *Legal aspects, Feed lots, Agriculture, Biochemical oxygen demand, Effluent, Water pollution, Odor, Zoning, Waste treatment, Damages.
Identifiers: Manure, Nuisance, Site selection.

There are two types of regulations under which a livestock farmer can be prosecuted or fined for environmental damage. The first are public regulations, such as the States and Federal Government have promulgated in the Water Quality Act of 1965 and comparable State bills, These laws usually provide objective criteria for matter discharged into water or air, for example, maximal BOD levels for effluents discharged into streams. Private regulation usually takes the form of nuisance laws, where the more objective human tolerance for noise, odor, or water pollution is given a legal form. A farmer who endangers his neighbors' health, well-being, or livelihood by polluting their water supplies, or making their air foul-smelling is subject to damage suits, injunctions, fines, or a combination of these. Zoning helps to minimize suits since it insures that the land use is not unreasonable in itself. However, a farmer in a zoned agricultural area may still produce a nuisance and be taken to court. Selecting a site for livestock pens as far as possible from homes and complying with all existing State laws and codes can not only abate the pollution generated by a farm creating a hazard but indeed has done what the law requires. Waste treatment facilities are the single best insurance against legal action, and farmers and agricultural engineers should cooperate to draft realistic and practical laws in agricultural waste control. (Solid Waste Information Retrieval System).

### 1553-A8, D3, E3
### BIODEGRADATION OF ANIMAL WASTE BY LUMBRICUS TERRESTRIS
University of Georgia College of Agriculture Experiment Stations, College Station, Athens.
O. T. Fosgate, and M. R. Babb.
Journal of Dairy Science, Vol. 55. No. 6, p. 870-872, 1972. 1 tab, 4 ref,

Descriptors: *Farm wastes, *Recycling, *Waste treatment, Biodegradation, Lime, Proteins, Cattle, Dairy industry.
Identifiers: *Earthworms, *Lumbricus terrestris, *Potting soils, Cats, Dead animal disposal.

Earthworms on a diet of raw dairy cattle feces and water with sufficient lime added to maintain a pH of 7.0 produced 1 kg of worms for each 2 kg of dry fecal matter. The earthworm castings, a loose friable humus type of soil containing three per cent nitrogen, provide an excellent greenhouse potting soil weighing half as much as the usual potting soil and providing more flowers on more strongly rooted plants. The earthworm meal, containing 58 per cent protein and 2.8 per cent fat, is very palatable to domestic cats. (Whetsone, Parker, and Wells-Texas Tech).

### 1554-C3, D2
### TECHNIQUES FOR THE ENUMERATION OF ANAEROBIC MICROBES IN WASTE FERMENTATION SYSTEMS
Department of Agricultural Engineering, University of Kentucky, Lexington.
H. E. Hamiltin, I. J. Ross, and S. W. Jackson.
Presented at 1971 Winter Meeting of the American Society of Agricultural Engineers, Chicago, Illinois, December 7-10, 1971, Paper No. 71-570, 19 p., 9 fig., 4 ref.

Descriptors: *Farm wastes, *Anaerobic bacteria, *Fermentation, *Waste treatment, *Analysis, Equipment, Design, Livestock, Diseases, Poultry, Sampling.
Identifiers: *Microbes, *Plating, Manure, Rumen.

Although procedures for plating and counting microbes, in aerobic and anaerobic conditions, are well established, they are, especially under anaerobic conditions, extremely time-consuming and difficult. Special equipment is needed, particularly when large quantities of materials are to be analyzed. Autoclaved poultry manure was fermented with rumen microbes in this study; new equipment and procedures were designed for this purpose. A rumen sampling device, consisting of a stainless steel wire mesh cyclinder covered with two layers of cheesecloth and attached to a stainless steel tube, served as a probe and filter. This permitted rumen to be removed from a fistulated steer under anaerobic conditions. A special dispensing needle made possible the preparation of culture tubes at a rate of about 175 per hour. By placing a rack with a series of manifolds under a plastic hood, a number of test tubes could be inoculated rapidly. Colony counting equipment reduced the time needed to mark tubes and count colonies. (Solid Waste Information Retrieval System).

## 1555-A2, C3, E3
### ENTEROBACTERIA IN FEEDLOT WASTE AND RUNOFF
Northern Regional Research Laboratory, Northern Marketing and Nutrition Research Division, Agricultural Research Service, U. S. Department of Agriculture, Peoria, Illinois.
G. I. Hrubant, R. V. Daugherty, and R. A. Rhodes.
Applied Microbiology, Vol. 24, No. 3, p. 378-383, September, 1972. 6 tab, 12 ref.

Descriptors: *Feed lots, *Farm wastes, *Runoff, Waste disposal, Recycling, Sampling, Microorganisms, Cattle.
Idenitfiers: *Enterobacteria, Manure, Refeeding, Health hazards.

Refeeding of wastes is currently being investigated as a possible means of combating vast accumulations of waste from animal production. However, little attention has been given to the possible microbiological aspects of feedlot waste. This study was done to determine the types of microflora found in feedlot waste and associated sites. Samples were taken from feedlot waste, runoff from the pens, and water from a large drainage ditch at the feedlot, and they were examined for Enterobacteriaceae. Five-hundred and fifty-three cultures were isolated in all. Feedlot waste contains about 50,000,000 enterobacteria per gram. More than 90% of these were Escherichia coli. Enrichment techniques allowed isolation of four Proteus spp., both Providencia spp., Klebsiella, Enterobacter aerogenes, Arizona, and single isolate of Salmonella. Neither Arizona nor Salmonella were isolated from the drainage ditch or runoff. Results indicate that the refeeding of unsterilized feedlot waste is potentially hazardous due to the wide spectrum of enterobacteria found in these wastes. (Russell-East Central).

## 1556-A5, A8, E2
### RELATIVE LEACHING POTENTIALS ESTIMATED FROM HYDROLOGIC SOIL GROUPS
U. S. Department of Agriculture, Hydrograph Laboratory, Beltsville, Maryland 20705.
G. B. England.
Water Resources Bulletin, Vol. 9, No. 3, p. 590-597, June, 1973. 2 fig., 2 tab, 7 ref.

Descriptors: *Leaching, *Groundwater pollution, Soils, Percolation, Soil profiles, Agricultural chemicals, Water pollution, Runoff, Rates of application, Fertilizers, Nitrates.
Identifiers: *Hydrogen soil groups.

The problem of pollution has caused many questions to be asked concerning additives to the soil. It is very hard to determine the effects of leaching with respect to chemicals on or in the soil. Leaching with water can be both hazardous and beneficial. But it always can be considered potentially hazardous if leaching occurs on soils whose applied agricultural chemicals are improperly planned. One reason for the difficulty of determining the effects of leaching is the difficulty in determining soil permeability. Curves used by the Soil Conservation Service in flood control planning offer a reliable estimate of the amount of water expected to infiltrate the soil and take subsurface paths. Rates on which the Soil Conservation Service Hydrologic Soil Groups are based give the best estimate of the rate of flow through saturated profiles. This information should help in planning applications with minimum loss. (Russell-East Central).

## 1557-A3, A5, A8, E2
### MOVEMENT OF NITRATES UNDER IRRIGATED AGRICULTURE
College of Engineering and Architecture, Nebraska University, Lincoln.
D. M. Edwards, P. E. Fischbach, and L. L. Young.
Transactions of the ASAE, Vol. 15, No. 1, p. 73-75, 1972. 6 fig., 14 ref.

Descriptors: *Nitrates, *Irrigation, *Groundwater pollution, *Soil contamination, Fertilizers, Nitrogen, Soil profiles, Runoff.

This study was undertaken to determine the movement of nitrate nitrogen under irrigated agriculture. It was designed to help shed some light on the growing problem of nitrate pollution of soil and groundwater. Laboratory and field studies were undertaken with nitrates being added to the subsurface of the soil. Results indicate that with a properly designed irrigation system, little or no nitrate movement should occur outside the root zone. Field studies also indicate that a runoff water re-use system is necessary to prevent pollution of surface waters if irrigation is occurring on fields to which nitrogen fertilizer has been added. Other conclusions are that once nitrates enter the soil surface they do not re-enter the runoff water, except possibly through erosion. Also nitrates were found to move with the wetting front when the soil is dry, but they do not if the soil is initially saturated. (Russell-East Central).

## 1558-A2, C1, C2, D1, D3, F6
### LABORATORY STUDIES ON FEEDLOT RUNOFF
Department of Civil Engineering, Nebraska University, Lincoln.
T. J. McGhee, L. R. Christenson, and W. R. Bonneau.
Journal of Environmental Engineering Division, ASCE, Vol. 99, No. EE6, p. 883-896, December, 1973, Proceedings Paper 10205. 8 fig., 5 tab, 16 ref.

Descriptors: :Feed lots, *Agricultural runoff, *Farm wastes, *Waste treatment, Sedimentation, Retention, Biochemical oxygen demand, Aeration, Activated sludge, Adsorption.
Identifiers: Color removal.

'A field unit at the University of Nebraska revealed that effective treatment of settled feedlot runoff may be obtained at liquid retention times of 2 days with a positive solids return activated sludge system. The oxygen demand of feedlot runoff is not measured adequately by the 5 day biochemical oxygen demand determination but may be approximated from the chemical oxygen demand determination. The oxygen uptake of feedlot runoff as measured in the Warburg apparatus is a power function of time for at least 90 days. Removal of color is possible by adsorption on both activated carbon and clayey fine sand. Pretreatment is important since the adsorptive capacity of any such medium is limited. (Cartmell-East Central).

## 1559-D2, E3, F6
### SYNTHESIS GAS FROM MANURE
Department of Chemical Engineering, Texas Tech University, Lubbock.
K. L. Herzog, H. W. Parker, J. E. Halligan.
Presented at the 73rd National Meeting of the American Institute of Chemical Engineers, Detroit, Michigan, June 3-6, 1973, 17 p., 5 fig., 3 tab, 7 ref.

Descriptors: *Gases, *Farm wastes, *Recycling, *Synthesis, Cattle, Feed lots, Oxidation, Hydrogen, Ammonia, Methane.
Identifiers: *Manure.

With ammonia synthesis gas the objective, bench-scale studies of the partial combustion of cattle manure have been made. Results for continuous partial oxidation of −40 +60 sieve manure particles at feed rates up to 0.17 lb/hr in a 1.6 inch I.D. fluidized bed reactor are presented. The effect of increased reaction temperature, which was studied from 1285 to 1432 degrees, was to more than double ultimate $H_2$ yields from 8.5 to 18.5 SCF/lb dry, ash-free manure. These ultimate yields of hydrogen, which include projected conversions of the experimental yields of hydrocarbon gases, show that, given manure from 600,000 feedlot cattle, ammonia production of up to 920 tons/day can be achieved. (Herzog, Parker, Halligan-Texas Tech).

## 1560-A4, A5, A7, C3
### ANALYZING BIOLOGICAL PROPERTIES OF WASTES
Department of Microbiology, Colorado State University, Fort Collins.
S. M. Morrison, and K. L. Martin.
Preprint copy, 12 p., 27 def.

Descriptors: *Analysis, *Farm wastes, *Tests, Pathogenic bacteria, Air pollution, Water pollution, Bacteria, Coliforms, Sampling, Microorganisms, Ecology.
Identifiers: *Biological properties, Quantitative measurements, Fecal coliforms, Fecal streptococci, Total plate count, Pollution.

Because of the growing concern in the control of pollution and environmental hazards it is imperative that some sort of standardization of tests be developed in the field of waste analysis. Many of the problems encountered in the analysis of animal wastes are caused by the variability of the crude product. Measurements or analyses of domestic animal wastes fall into three main categories: (1) standardized tests that have gained professional, governmental, and judicial status; (2) tests which detect disease-causing organisms; and (3) tests for organisms that cause pollution to the environment and are involved in the aesthetic quality of agricultural businesses. The basic standardized tests are for total coliforms, fecal coliforms, enterococci or fecal streptococci, and total plate counts. In the detection of pathogenic organisms there are standardized tests for a broad array of organisms. In the tests for organisms that cause pollution, variables such as temperature, pH, salts, nutrients, oxygen, moisture, nitrogen compounds, and minerals should be taken into account because they affect the growth of organisms. (Russell-East Central).

## 1561-A8, E2
### EFFECTS OF CATTLE FEEDLOT MANURE ON CROP YIELDS AND SOIL CONDITIONS
USDA Southwestern Great Plains Research Center, Bushland, Texas,
A. C. Mathers, B. A. Stewart, J. D. Thomas, B. J. Blair.
Research Center Technical Report Number 11, Texas Agricultural Experiment Station, Texas A&M University, December, 1972, 13 p., 6 fig., 1 tab.

Descriptors: *Farm wastes, *Feed lots, *Cattle, *Crops, *Waste disposal, Nitrates, Salts, Analysis, Irrigation, Soils, Physical properties, Chemical properties, Rates of application.
Identifiers: *Yields, *Soil conditions, *Land spreading, Saturated paste extracts, Plowing depths.

Data suggests that manure applications of 10 tons per acre furnish adequate nitrogen for most crops without high salt buildup in the soil. Also applications of 10 tons per acre do not effect organic levels of the soil. Higher rates of manure can be added to soil without lowering yields of the soil. Deeper plowing depths usually alleviate this problem. Conclusions of manure application suggest that at just 10 tons per acre, land area in even the most concentrated feeding areas is adequate to dispose of the manure. In fact only about one-fourth of the cropland in Texas used for grain sorghum alone would have to be treated to dispose of the manure. The challenge is to develop distributing and handling systems to spread the manure on croplands most beneficially. (Russell-East Central).

## 1562-A11, A12, C2, E3, F1
### REFEEDING FEED
G. Sollenberger.
The Furrow, Vol. 79, p. 12-13, April, 1974. 3 fig.

Descriptors: *Recycling, *Farm wastes, *Feeds, *Cattle, Feed lots, Poultry, Waste disposal, Oxidation ditch, Waste treatment, Silage, Proteins, Solid wastes.
Identifiers: *Refeeding.

Due to the increase in confinement livestock production, a growing effort is making manure feeding a more systematic practice. Large-scale recycling of manure for feed might solve some of the waste-disposal and pollution problems that confinement operations often create. Analyses show that livestock wastes contain 12 to 40% protein and 40 to 70% carbohydrates and are produced at an annual rate of from 1.5 to 2 billion tons. Experiments with recycling raw manure from feedlot cattle as feed have had promising results. Poultry waste and straight litter also show promise as a ration ingredient. An alternative to feeding waste itself is using it as nutrition for various organisms that can then be fed to cattle. However, before a large scale commercial recycling program can begin, many more tests must be conducted to examine the economics, nutrition, and safety of recycling wastes. But, the concensus seems to be that whatever the problems, they can be overcome, and there is no reason to doubt that animal wastes will be a great asset in the future production of meat protein. (Russell-East Central).

### 1563-A11, 12, E3
### RECYCLING DPW FOR GREATER RETURN

Texas A&M University.
J. R. Couch.
Poultry Digest, Supplement, Vol. 33, No. 384, P. A-1-A-7. 4 fig.

Descriptors: *Recycling, *Feeds, *Poultry, Ruminants, Protein, Nitrogen, Phosphorous, Farm wastes, Waste treatment, Waste disposal, Nutrients.
Identifiers: *DPW, *Dried Poultry Waste, Laying hens, Uric acid, Chicks, Manure, Turkeys.

Dehydrated poultry manure contains about 10% true protein which may contribute significant amounts of essential amino acids and phosphorous in formulated feeds. Growing chicks can tolerate up to 5% DPW without adverse effects. DPW can compose up to 25% of the total ration of laying hens. It has been estimated that the nutrient utilization of the essential nutrients found in DPW will be 30-35%. From the data reported, it is apparent that it is not possible to recycle more than about 25% of the total manure produced by laying hens. This leaves 75% of the fecal material to be disposed of through other waste management procedures, it has also been found that ruminants can efficiently utilize both the true protein and the nitrogen originating from uric acid. Satisfactory performance has been obtained from feeding poultry waste levels up to 50% of the total ration. The use of poultry wastes in cattle feeds would appear to be much more desirable than the use in poultry feeds. (Russell-East Central).

### 1564-B5, C1, C2, D1, D2
### SHORT-TIME, HIGH-TEMPERATURE EXTRUSION OF CHICKEN EXCRETA

Agricultural Engineering Department, Kentucky University, Lexington.
F. A. Payne, I. J. Ross, H. E. Hamilton, and J. D. Fox.
Transactions of the ASAE, Vol. 16, No. 4, p. 750-754, July-August, 1973. 6 fig., 17 ref.

Descriptors: *Poultry, *Temperature, *Farm wastes, Heat, Moisture content.
Identifiers: *Extrusion, *Chicken exrcreta, Sterilization, Chemical analysis, Uric acid, Microbial analysis,

A study was done to determine the feasibility of applying an extrusion cooking process for the sterilization of chicken excreta and a chicken excreta-feed mixture and to determine some of the chemical and physical changes in the materials resulting from this process. This short-time, high-temperature process has versatility, a high productivity, low cost, and offers the ability to control the time-temperature relationship. An experimental extruder consisting of a plunger, barrel and an electrically heated die was constructed for the tests. The sterilization parameters were found to be in the range of those commonly used in food processing, but the test design was not sufficient to prove the theoretical development. However, based on the microbial parameters estimated, an extruder could be used to sterilize chicken manure. The extrudate was analyzed for changes in uric acid, ether extract and total nitrogen. The only significant change found was the decrease in ether extract of the chicken excreta-feed mixture with increasing extrusion temperature. Loss of moisture associated with flash volatilization and evaporative cooling was determined. (Cameron-East Central).

### 1565-A2, A4, A5, A7, B1, C2, C3, D1, D2, D3, E1
### DAIRY WASTE MANAGEMENT

Albert A. Webb Associates.
Albert A. Webb Associates, Consulting Engineers, Riverside, California, March, 1974, 177 p., 34 fig., 36 tab, 44 ref.

Descriptors: *Dairy industry, *Farm wastes, *Management, *California, *Water quality, *Water pollution, *Waste disposal, *Watersheds, Bacteria, Runoff, Salts, Leaching, Recycling, Equipment, Economics, Costs, Air pollution.
Identifiers: *Santa Ana River Basin, Composting, Sanitary landfill.

One of the most producitve regions in Southern California is the Santa Ana River Basin. However, over the years the water quality and quantity have been difficult to maintain. Recognizing the problem, a cooperative effort which will supply water users a continuous supply of good quality water was undertaken. Some of the major problems faced in the Santa Ana Watershed are: (1) salt imbalances which threaten ground water supplies; (2) excess nitrates in the domestic water supplies; and (3) bacterial and viral contamination of surface waters. This study was designed to determine economically feasible methods by which the dairy industry could reduce the amount of salts added to the ground water of the basin to 0.3 ton per acre per year. This study involves a survey of the problems in the valley with: an evaluation of the waste streams from individual cows to the dairy; methods of collecting, treating, and disposing of these waste streams; the economic and organizational aspects of doing this; and recommendations of a plan to achieve the objective. (Russell-East Central).

### 1566-B1, E3, F2
### CORN, MANURE AND SILAGE MAKE AN EXOTIC RATION

Successful Farming, Vol. 72, No. 5, p. B10-B11, March, 1974. 5 fig.

Descriptors: *Silage, *Feeds, *Recycling, *Farm wastes, *Feed lots, *Cattle, Performance, Costs, Management.
Identifiers: *Corn, *Manure, *Refeeding.

The key to making refeeding animal wastes practical is to mechanize handling and to develop proper management of the unusual feed. A Georgia feedlot owner feeds a mixture of 45% cracked shelled corn, 15% corn silage and 40% manure to his cattle. The ingredients are mixed in a large mixer wagon and blown into a sealed silo, After fermenting, the sweet smelling feed makes a 12% protein ration that includes 70% total digestible nutrients. The mixture is cheap and efficient and handling is easy. Rate of gain is nearly a quarter of a pound more per day than on a normal ration (80% shelled corn, 7% hay and 12% protein supplement). The Federal Drug Administration allows farmers and feedlot operators to recycle waste from their own operation. (Cartmell-East Central).

### 1567-A6, B1, C2, D3, E3
### SOLID SUBSTRATE FERMENTATION OF FEEDLOT WASTE COMBINED WITH FEED GAINS

Agricultural Research Service, U. S. Department of Agriculture, Northern Regional Research Laboratory, Peoria, Illinois.
R. A. Rhodes, and W. L. Orton.
Presented at the 67th Annual Meeting of American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 84-3032, 18 p., 5 fig., 4 tab, 10 ref.

Descriptors: *Farm wastes, *Feed lots, *Waste treatment, *Fermentation, *Feeds, *Proteins, *Recycling, Odor, Liquid wastes, Nitrogen, Incubation, Aerobic conditions, Bacteria.
Identifiers: *Grains, *Refeeding, *Solid substrate fermentation.

Manure is recognized as being a potential nutrient source for feed, and generally the manure is fed directly as a nitrogen source. But a new and different process is being developed involving ensilage of the liquid fraction of feedlot waste and cracked grains. This process is called solid-state fermentation. The liquid contains 10% solids in the form of microbial cells and fine waste components. When added to cracked grain such as corn the thick liquid adheres to grain surfaces. The grain-waste mixture is incubated by tumbling slowly in a revolving vessel and rapidly undergoes acid fermentation caused by the growth of lactic acid bacteria. Yeasts emerge after incubation, and the bacteria cells grow rapidly. The odor quickly disappears as 0.1 meq of acid per gram is generated, but the nitrogen is conserved. Lactic, acetic, proprionic, and butryic acids are formed in the process. The fermented product has 18% more protein than the unfermented grain. This process shows positive results for the generation of higher protein content grain-based rations. (Russell-East Central.

### 1568-A1, A9, F3
### NONPOINT AGRICULTURAL POLLUTION: STATUS OF ASSESSMENT METHODOLOGY

Midwest Research Institute, Kansas City, Mo.
A. Aleti, S. Y. Chiu, and A. D. McElroy.
Presented at the 67th Annual Meeting of American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No, 74-4025, 16 p., 2 fig., 2 tab, 27 ref.

Descriptors: *Agriculture, *Water pollution, *Model studies, Nutrients, Microorganisms, Pesticides, Salts, Runoff, Pollutants.
Identifiers: *Nonpoint pollution, Prediction, Sediment.

Agriculture is a major contributor to nonpoint pollution. Agriculture pollutes water quality with such substances as sediments, salts, nutrients, pesticides, biodegradable organics, and microbial populations. These pollutants are the results of natural factors and source practices. The present difficulty with nonpoint pollution control is the inability to assess, in quantitative terms, the effect of control measures. The overall need is to develop comprehensive models which include all pollutants, which are sensitive to the causes of these pollutants, and which recognize interdependencies between pollutants in order to facilitate development of simplified control measures. Some of the needs basic to the construction of these models are: data gaps; analyses of transport phenomena; evaluation of current and past case studies; model-orientated case studies conducted on a wide scope; collection and storage of information; and, systematic analysis of large volumes of data. (Russell-East Central).

### 1569-D2, E3, F6
### CRUDE OIL FROM MANURE

C. Gross.
Calf News, Vol. 9, p. 3, October, 1971.

Descriptors: *Farm wastes, *Oil, *Organic wastes, *Feed lots, *Recycling. Cattle.
Identifiers: *Manure.

Dr. G. Alex Mills, Chief of the U. S, Bureau of Mines Energy Research Center in Pittsburgh, has perfected a pilot project in which organic waste and carbon monoxide are subjected to 1200 psi pressure at a temperature of 720°F. "Voila! You've got crude oil!" Two tons of manure yield a ton of oil with a BTU content of 14,000-16,000 per lb., and a ton of water. The low-sulphur oil is excellent for power plants. The nation's total annual manure supply would provide about one-half the nation's annual oil requirements. (Whetsone, Parker, Wells-Texas Tech University).

## 1570-A2, A4, A5, B1, B4, C2, E2, F4

### STREAM POLLUTION FROM ANIMAL PRODUCTION UNITS

Agricultural Engineering Department, Louisiana Technical University, Ruston.
J. W. D. Robbins, D. H. Howells, and G. J. Kriz.
Journal Water Pollution Control Federation, Vol. 44, No, 8, p. 1536-1544, August, 1972.

Descriptors: *Water pollution, *Streams, *Feed lots, Lagoons, Anaerobic conditions, Agricultural runoff, Waste storage, Design, Rainfall, North Carolina, Sampling, Waste disposal, Livestock, Hogs, Chemical analysis, Nutrients, Discharge measurement, Design criteria.
Identifiers: Land spreading, Plowing.

This report summarizes a 2-year study of actual and potential pollution from animal production facilities. The investigation included: assessment of present animal waste management practices; measurement of pollutants reaching streams from 12 typical agricultural sites in North Carlina; development of predictive relationships to estimate the pollution potential of similar animal production units; development of recommendations for corrective action; and identification of researchable problem areas. The following conclusions were made. Anaerobic lagoons as the sole means for animal waste treatment is an unsatisfactory practice in areas where rainfall exceeds evaporation. Although the amount of surface discharge and resulting stream pollution from lagoons can be lessened by reducing the amount of wash water, diverting runoff and locating lagoons to prevent subsurface inflow, at least intermittent subsurface discharge occurs unless deep seepage is excessive. Research is needed to develop reliable design standards for storage lagoons with economical secondary treatment units. The practice of dumping fresh animal wastes directly into streams causes excessive pollution and should be prohibited. The natural pollution load on streams draining agricultural basins devoid of farm animals can be appreciable under certain rainfall conditions and should be taken into consideration in water quality management. Land spreading of manure is a very effective means of minimizing water pollution. (Solid Waste Information Retrieval System).

## 1571-E3, F4

### ENERGY POTENTIAL FROM ORGANIC WASTES: A REVIEW OF THE QUANTITITES AND SOURCES

Utah University.
L. L. Anderson.
U. S. Bureau of Mines. Information Circular 8549, 1972, 16 p., 3 fig., 3 tab, 26 ref.

Descriptors: *Organic wastes, *Energy, *Farm wastes, *Fuels, *Waste treatment, *Waste disposal, Oil, Gases, Sewage, Industrial wastes, Cattle, Feed lots, Livestock, Recycling.
Identifiers: *Quantities, *Sources, Refuse, Manure, Crop wastes, Conversion, Logging residues.

Enormous quantities of organic wastes are produced each year in the United States. The total amount is in excess of 2 billion tons and at least 800 million tons of this is moisture-and ash-free organic material (dry organic solids), representing a potential energy source of significant magnitude that is not being utilized. Bureau of Mines scientists have developed methods for converting these wastes to convenient energy forms. This report itemizes and evaluates for the first time in detail the quantities and sources of moisture-and ash-free organic material contained in manure, urban refuse, industrial wastes, sewage solids, and agricultural wastes in the United States. Furthermore, estimates are presented for amounts of organic wastes collected or concentrated. The potential for fuel, either oil or gas, from both the total organic wastes generated and those collected or concentrated is also estimated. (Anderson-Utah

## 1572-B1, D1, D3, E3

### NEW AEROBIC PROCESS TURNS WASTE TO NUTRIENTS

AgChem and Commercial Fertilizer, Vol. 27-28, No. 12-1, p. 24-27, December 1972-January, 1973. 7 fig.

Descriptors: *Farm wastes, *Nutrients, *Fertilizers, Feed lots, Cattle, Water, Feeds, Urine.
Identifiers: *Aerobic process, Manure, Digestor.

The first animal-waste, large scale sterilized organic fertilizer capability is being devoleped by the operator's of Ohio Feed Lot—the world's largest pollution-free enclosed cattle feedlot. Cattle manure is collected by front-loading tractors, dumped into large fan ventilated vats and fed to an aerating digestor. Once the manure is sterilized it is then bagged and packaged in 5, 10, 25, and 50 pound bags of organic fertilizer and sold. Great pains have been taken to make this feedlot operation as self sufficient and environmentally ameliorating as possible. Utilization of natural air flow (aided by fans), the creation of an impermeable feedlot surface, and the development of a guarded cattle diet using the feedlot's own corn-based feed all contribute to the creation of the completely self sustaining and ecology-proof environment that Ohio Feedlot founder W. C. Hackett hopes to develop. (Drewry-East Central).

## 1573-A6, B1, C2

### GASES AND ODORS IN CONFINEMENT SWINE BUILDINGS

Department of Agricultural Engineering, Illinois University, Urbana.
D. L. Day, E. L. Hansen, and S. Anderson.
Transactions of ASAE, Vol. 8, No. 1, p. 118-121. 1965. 117 fig., 7 tab, 11 ref.

Descriptors: *Gases, *Odor, *Confinement pens, *Hogs, *Farm wastes, Slabs, Ammonia, Carbon dioxide, Hydrogen sulfide, Methane, Waste storage.
Identifiers: *Confinement buildings, *Swine, *Manure, Slotted floors.

The objective of this investigation was to qualitatively analyze the gases and odors produced in confinement swine-finishing building, with and without fluid manure waste handling. A cold trap gas collector was used in an attempt to concentrate condensable gases from the building atmosphere. Ammonia was found in the solid-floor building that was cleaned daily by scraping. The odors in this building, which were very strong and offensive, were collected on a special glass-fiber paper along with feed and dust particles in the atmosphere. Gases detected in the totally slotted-floor building with underfloor pits were carbon dioxide, hydrogen sulfide, methane, and possibly ammonia. They were evidently produced by the biological activity in the ponded wastes. Thus far, there have been no conclusive tests of detrimental effects of the gases and odors on the pigs. However, there have been numerous reports of an unexplained decrease in the rate of gain at about 150 lb. in weight when pigs were raised in confinement buildings with underfloor ponded wastes held in the building for a month or longer. The cold trap, as operated, was not effective in concentrating contaminant gases in the condensate to the extent that they could be analyzed with infrared spectroscopy. (Cartmell-East Central).

## 1574-A2, A4, A5, A8, B2, B4, E2

### THE EFFECTS ON RUNOFF, GROUNDWATER, AND LAND OF IRRIGATING WITH CATTLE MANURE SLURRIES

Tennessee University, Department of Agricultural Engineering, Knoxville.
J. I. Sewell, and J. C. Barker.
Research Report No. 31, Tennessee Water Resources Research Center, Knoxville, October 4, 1973, 26 p., 7 fig., 4 tab, 3 ref.

Descriptors: *Farm wastes, *Cattle, *Water reuse, Waste disposal, Slurries, *Waste management, *Organic wastes, Irrigation, Water quality, Groundwater, Surface runoff, Nitrates, Bacteria, Southeast U. S., Tennessee, Humid climates, Path of pollutants.

The manure slurry irrigation system receiving lot runoff has performed satisfactorily and has been durable. Careful management is required to maintain storage capacity for lot runoff while controlling surface runoff of irrigated slurry. Dilution water must sometimes be added to the storage tank to facilitate solids removal. Dry-matter contents of slurry up to about 4 percent did not appreciably reduce system discharge rates. Manure slurry apparently infiltrated into the shallow groundwater on the downslope side of the test area. Surface runoff from the manure-saturated area on occasions contained both total and fecal coliform median concentrations exceeding the maximum standard for raw surface water for public supplies. All median surface runoff nitrate nitrogen concentrations were within the permissible criteria. An average application rate of 5.55 tons of dry matter per acre per month applied in the form of dairy manure slurry presented no problems of solids accumulation on the ground surface. Field irrigation with the manure slurry resulted in a 90% reduction in the total solids content of surface runoff and groundwater compared with that of the slurry. (Sewell-Tennessee University).

## 1575-A2, B1, F1, F2

### EFFECT OF FEEDLOT LAWS AND CLIMATE ON OPEN FEEDLOT WASTE MANAGEMENT

Department of Agricultural Engineering, Oklahoma State University, Stillwater.
A. F. Butchbaker, J. E. Garton, G. W. Maloney, and M. Paine.
Presented at 65th Annual Meeting, American Society of Agricultural Engineers, June 27-30, 1972, Hot Springs, Arkansas, Paper No. 72-438, 38 p., 12 fig., 6 tab, 16 ref.

Descriptors: *Feed lots, *Regulation, *Legal aspects, *Climates, *Farm wastes, *Management, *Design, Costs, Precipitation (Atmospheric), Storms, Evaporation, Water pollution, Irrigation, Solid wastes.
Identifiers: Storm rainfall, Open feed lot, Holding pond.

The effects of climate and the impact of feedlot laws on waste management systems were examined. Analysis of the engineering design requirements for feedlots was made by searching the literature, observing feedlot operations, performing operational analysis of waste handling systems, and from personal conversations. Feedlot laws for regulating runoff control are aimed at reducing the water pollution potential by means of holding ponds. For the waste management systems, the major climatic factors are: annual precipitation, storm rainfall, annual evaporation, and temperature. Analysis of the various alternatives for handling the feedlot waste was done by analyzing the field observations and utilizing the computer to generate design information to perform calculations for comparing the cost of various systems. For a 20,000 head open feedlot with pollution control, the total system costs (feedlot construction plus waste management systems) are approximately 0.01319 dollars per animal day with an investment cost of approximately $416,000. (Cartmell-East Central).

### 1576-B2,B3,B4,E2,E3,F3
### THE RELATIONSHIP BETWEEN ANIMAL WASTES AND WATER QUALITY

Environmental Protection Agency. President's Water Pollution Control Advisory Board.
President's Water Pollution Control Advisory Board, Environmental Protection Agency Report of Recent Meetings, October, 1971 and January, 1972. 33 p.

Descriptors: *Farm wastes, *Water quality, Recycling, Waste disposal, Lagoons, Basins, Fuels, Oil, Gases, Fertilizers, Feeds, Research and development, Feed lots, Water pollution, Runoff, Colorado, Nebraska, Kansas, Illinois, Indiana, Public health, Monitorings, Strip mines.
Identifiers: *Animal waste, Land disposal, Building materials, Refeeding, Site selection.

The Board held meetings in Colorado 26-29, Oct. 71 and in Illinois and Indiana 24-28, Jan. 72 to hear testimony on the animal waste pollution problem. Field trips were combined with both meetings. The paper summarizes the hearings. As a consequence of the meetings, the Board presented ten recommendations to EPA. That on uses of animal wastes is: "The Board believes that recycling animal wastes back onto the land is the best practical approach in most situations, particularly for smaller operators, through the use of catchment basins, lagooning systems, and/or solid waste handling techniques. There are also other possible uses which should be given full consideration. Testimony presented to the Board indicates that promising possibilities exist in converting animal wastes into fuels such as oil or back into animal feeds. It is recommended that the Environmental Protection Agency give high priority to funding for research and development projects which may develop practicable and safe alternate uses for animal wastes." (Whetsone, Parker, Wells-Texas Tech University).

### 1577-D3, E3
### GE OPENS RECYCLING PLANT

Calf News, Vol. 10, p. 34, 80-81, October, 1972. 2 fig.

Descriptors: *Recycling, *Arizona, *Farm wastes, *Cattle, *Feeds, Thermophilic bacteria, Proteins, Livestock, Organic wastes, Feed lots, Nutrients.
Identifiers: *General Electric Company, *Recycling plant, *Refeeding.

GE opened a test facility at Casa Grande, Arizona, on 31 August to treat the wastes from 100 head of cattle by means of thermophilic bacteria to produce a pasteurized high-protein livestock feed supplement. Cattle manure consists largely of plant fiber constituents digested only slowly by usual strains of bacteria. Results are expected by mid-1973. (Whetsone, Parker, Wells-Texas Tech University).

### 1578-A8, E2, F1
### MANURE PROMOTED FOR CROPLAND

Calf News, Vol. 10, p. 18, December, 1972.

Descriptors: *Farm wastes, *Crops, *Fertilizers, Rates of application, Salts, Nitrates, Irrigation, Costs, Nebraska, Nutrients, Feed lots, Soil contamination, Water pollution, Soils, Slopes.
Identifiers: *Manure, Soil conditioner, Yields.

Manure acts as a fertilizer; buffers alkaline soils; and improves porosity, granulation, water infiltration rate, and moisture retention. Residual effects may result in a profit even where handling costs exceed one-year value. Salt accumulation should be checked. Maximum application rates recommended are 10-15 tons/acre depending on precipitation and irrigation practices. Brief notes on the same page report increased hay yields on manure-fertilized land in California anud warn of nitrate pollution in Nebraska. (Whetsone, Parker, Wells-Texas Tech University).

### 1579-A7, A11
### INFLUENCE OF DUST AND AMMONIA ON THE DEVELOPMENT OF AIR SAC LESIONS IN TURKEYS

Department of Veterinary Science, Wisconsin University, Madison,
D. P. Anderson, R. R. Wolfe, F. L. Cherms, and W. E. Roper.
American Journal of Veterinary Research, Vol. 29, No. 5, p. 1049-1058, May, 1968. 18 fig., 5 tab, 8 ref.

Descriptors: *Dusts, *Ammonia, Poultry, Air pollution, Mortality.
Identifiers: *Air sac lesions, *Turkeys, Feed conversions, Airsacculitis.

This experiment was undertaken to determine the effects that long exposure (10 weeks) to ammonia and dust air pollution have on turkeys living under conditions of commercial poultry production. Mortality, feed conversion, incidence of air-sacculitis, and histologic changes were the response criteria used. Four treatments were designated in terms of factor levels; A—high dust and low ammonia; B—low dust and high ammonia; C—high dust and high ammonia; and C—high dust and high ammonia; and D—low dust and low ammonia. The temperature was kept near 21°C. Increasing the dust concentration from the low to the high level caused more than doubling of the incidence of airsacculitis This occurred regardless of the mycoplasma infection rate. The turkeys exposed to treatment D were conspicious by the lack of lesions. The lesions in tissues of turkeys exposed to treatments, A, B, and C usually were loss of cilia from the columnar epithelial cells lining the lumen of the trachea, increase in mucus-secreting goblet cells in the trachea, consolidation and inflammation in areas of the lung, lymphocytic infiltration of air sacs, and occasionally masses of caeous exudate in the air sacs. (Cartmell-East Central).

### 1580-B1,C1,C2,C3,E3,F1
### MARKETING POULTRY MANURE

Pennsylvania State University, University Park.
H. C. Jordan.
Presented at Proceedings of the 1969 National Poultry Litter and Waste Management Seminar, September 29-30, 1969, University of Delaware Substation, Georgetown, p. 18-23,, 1 ref.

Descriptors: *Poultry,* Farm wastes, *Marketing, *Fertilizers, Drying, Bacteria, Odor, Nitrogen, Phosphorous, Additives.
Identifiers: *Manure.

Surveys were conducted in an attempt to find answers to the manure marketing problem. The questionnaire and the answers that were received are given in detail. The needs for a marketable product appear to be the following: (1) poultry manure must be dried to below 20 per cent moisture; (2) microbe count must be reduced; (3) aerobic bacteria that release $CO_2$ and water are the only ones that can be tolerated; (4) odor must be reduced; (5) nitrogen in the form of urea and uric acid must be fixed; (6) nitrogen, phosphorous and potash should be kept in original amount in the end product; (7) chemical and biological additives must be controlled for mushroom production; (8) the product must flow through a lawn spreader and be easy to handle; (9) the product must store without picking up water and giving off odor; (10) advertising and sale must be done without "poultry manure" in the name of the product. (Cartmell-East Central).

### 1581-C1, C2
### THERMAL PROPERTIES OF BEEF MANURE

Ghel Company, West Bend, Wisconsin,
R. L. Houkom, A. F. Butchbaker, and G. H. Brusewitz.
Presented at 65th Annual Meeting, American Society of Agricultural Engineers, June 27-30, 1972, Hot Springs, Arkansas, Paper No. 72-316, 34 p., 11 fig., 4 tab, 14 ref.

Descriptors: *Thermal conductivity, *Farm wastes, *Cattle, Specific heat, Bulk density, Physical properties, Chemical properties, Analysis, Equipment, Moisture content, Viscosity.
Identifiers: *Manure, *Thermal diffusivity.

Objectives of the experiment were to determine the effect of moisture content on the specific heat and thermal conductivity of fresh cattle manure, to determine the chemical and physical properties of manure for engineering application, and to estimate the thermal diffusivity of manure from experimental values of specific heat, bulk density, and thermal conductivity. Manure was analyzed at 25%, 65%, and 85% moisture levels. It was found that moisture content is statistically significant in variation of thermal conductivity. Specific heat is also dependent on moisture levels whereas thermal diffusivity appears to be independent of moisture levels. Particle density of beef cattle manure was about the same as dairy cattle manure, but particle size of the dairy manure averages larger than beef manure particles. It was also found that bulk density of manure reaches a maximum at about 65% moisture content with a great variation of bulk density and thermal conductivity between 45% and 65% moisture levels. (Russell-East Central).

### 1582-A6,A8,B2,B5,C1,C2,D3, E2
### MANAGEMENT OF SWINE WASTE BY A LAGOON SYSTEM

Agricultural Engineering Department, Cooperative Extension Service, Washington State University, Pullman.
R. E. Hermanson, and J. L. Koon.
Transactions of the ASAE, Vol. 16, No. 6, p. 1172-1174, 1178, Nov.-Dec., 1973, 4 fig., 1 tab, 9 ref.

Descriptors: *Management, *Farm wastes, *Hogs, Lagoons, Waste treatment, Water pollution, Aerobic treatment, Anaerobic conditions, Odor, Effluent, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Phosphorus, Bacteria, Sampling.
Identifiers: *Swine, Land disposal.

A two-stage anaerobic-aerobic lagoon system can provide a significant reduction in pollutional characteristics of swine waste. The addition of an aerated second stage to an anaerobic lagoon resulted in effluent with mean BOD and COD reductions in the aerated lagoon of 72 and 45%, respectively. A detention time of 2 weeks in the aerated lagoon resulted in average BOD and COD reductions almost equal to the 4 or 5 week detention time for the anaerobic lagoon. Total nitrogen was reduced an average of 18% for the 2 week detention in the aerated lagoon and 53% for the 9 week detention,. Although significant reduction in effluent concentrations were achieved, the end product was still quite polluted. The levels of BOD, COD, $N_2$, and P along with solids and color, in most states, limited the discharge of wastes from this two-stage system into receiving streams. Disposal on land was the only feasible alternative. The primary effect of the aerated lagoon was the reduction of odor and the amount of pollutants that the land was forced to handle. (Russell-East Central).

### 1583-A6,B2,B5,C1,C2,D3
### ANAEROBIC DEGRADATION OF SWINE MANURE MIXED WITH MUNICIPAL DIGESTER SLUDGE

Associate Agricultural Engineer, Metropolitan Sanitary District of Greater Chicago, Canton, Illinois.
J. L. Roll, D. L. Day, B. A. Jones, Jr., J. T. Pfeffer.
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, Paper No. 73-4521, 15 p., 3 fig., 6 tab, 8 ref.

Descriptors: *Anaerobic digestion, *Degradation (Decomposition), *Farm wastes, *Hogs, Waste storage, Waste treatment, Odor, Physical properties, Chemical properties, Sampling, Analysis, Gases.

Identifiers: *Manure, *Swine, *Municipal digester sludge.

This study was undertaken to determine if the addition of non-lagooned digester sludge to liquid swine manure aided anaerobic activity and odor control. There were two trials lasting two weeks each and a third trial lasitng forty-five days. All studies indicated that adding digester sludge to manure yielded excellent anaerobic digestion. Different manure-sludge ratios were tried, and it was found that a 2:1 manure to sludge mixture underwent the most digestion, but it also emitted the most odor. However, odor was always less when sludge was added than when manure was stored alone. So adding digester sludge to a holding pit may help control odors and aid in stabilization of the manure. It was concluded that odor control and increased degradation of waste is due to enhanced anaerobic activity. (Russell-East Central).

### 1584-A4. A12, B1, F2

### PRESENT AND FUTURE ZONING REGULATIONS AFFECTING LIVESTOCK PRODUCERS

B. A. Parks.
Unpublished paper, 4 p.

Descriptors: *Zoning, *Regulation, *Livestock, *Feed lots, *Legal aspects, Locating, Water pollution, Iowa, Livestock.
Identifiers: Municipal zoning, County zoning, Nuisance laws.

At the present time there are no zoning requirements on livestock facilities in the state of Iowa. As is true for all states, Iowa has granted the right to zone to local governments. But the different types of zones permitted by law makes no mention of farming, agriculture, or livestock feeding. Presently there are three primary controls which can apply to the location of feedlots, These are Health Laws. Nuisance Laws and Water Pollution Control Laws. Enforcement of health and water pollution laws are the most effective means of control. Nuisance laws can be employed, but these are usually not effective. There are two or three changes that might be made to the existing law if it is applied to livestock production. The major change would be to recind section 358A2 which grants agricultural exemption to county zoning. As a second alternative, the agricultural exemption might be retained with an amendment added which specifically subjects livestock production to zoning controls. A third alternative could be an opinion by a court that livestock production is subject to zoning. (Russell-East Central).

### 1585-A6, B2, D3, E1, F1

### NEW LIQUID MANURE SYSTEMS

Beef, Vol. 10, No. 8, p. 37-38, April, 1974. 2 fig.,

Descriptors: *Liquid wastes, *Waste disposal, Confinement pens, Lagoons, Effluent, Odor, Costs, Missouri, Design, Farm wastes, Waste treatment.
Identifiers: *Manure, *Flush system.

Flush systems manure handling is rapidly becoming one of the most prominent methods of waste disposal in the Midwest. The flush setup offers low original cost and promises to be relatively odor free. Many men have given their reasons of installing the flush system. Most give the reason that it is an efficient, inexpensive method of waste disposal. It is based on the concept of a single slot at the end of a concrete slab draining from the feedbank. Some have been installed in the open, while others have been in cold confinement barns, but all have proved to be satisfactory for proper removal. The effluent is flushed periodically from the slab to a lagoon. To be effective in this process, the lagoon must be loaded daily. If the lagoon is loaded at longer intervals, the bacteria action will not be effective. At least once a year the lagoon must be diluted. As a rule of thumb, about half of the lagoon should be removed and replaced with water. Perhaps the flush system will offer the best and cheapest method of waste disposal in areas where weather is not extreme. (Russell-East Central).

### 1586-A11, B1

### NEW ALUMINUM SLATS AND CONCRETE SLATS COMPARED

Feedlot Management, Voy. 16, No. 4, p. 10-11, April, 1974. 1 fig. 1 tab.

Descriptors: *Confinement pens, Cattle, Performance, Traction, Iowa, Tennessee.
Identifiers: *Aluminum slats, *Concrete slats.

Concrete slats have long been accepted for beef cattle feeding, but, due to the expenses and impracticality of concrete, aluminum is now being used in place of concrete. Experiments which compared aluminum and concrete slats were conducted at Alice Farm in Iowa. After three winters and two summers, data was evaluated. Results indicated that the average daily gain values for the two types of slats during the three winter tests were almost identical. Average feed conversion values were also very similar, During the summers, the gains were also similar, and although feed conversions slightly favored concrete, the difference was not significant. After numerous tests and changes, Alcoa researchers have developed the slats to the point that cattle also get the same traction as on concrete. The future of confinement feeding seems definitely to be going to aluminum slats instead of concrete. (Russell-East Central).

### 1587-A1,A6,A10,A11,B1,F1

### SLATS IN THE SOUTHWEST?

Editor, BEEF.
P. D. Andre.
Beef, Vol. 10, No. 1, p. 62, 70, 71, September, 1973, 3 fig.

Descriptors: *Confinement pens, *Performance, Cattle, Costs, Lagoons, Sprinkling, Waste disposal.
Identifiers: *Slats, Southwest U. S., Open feed lot.

Operational facilities are given for a confinement facility with a capacity for 10,000 head of cattle. The advantages of the confinement pen versus the open pens are given in detail. Only seven acres are needed for the confinement pen versus 30 for the open pens. Confinement, it is estimated, should save hiring two men, as compared to open lots, Since the feed truck only has to travel over seven acres rather than 30, another savings of $1,800 is listed. Among the other advantages are: more pleasant working conditions for employees, ease of handling animals, possible improvement in conversion rates and death loss, odor and fly control, pollution prevention, easier management and supervision, more consistent quality of beef, faster turnover of cattle at lighter weights, and longer total life of the facility. Severe performance slumps due to weather can also be avoided; consequently, management can project business more accurately. There is an estemated $100,000 yearly advantage for this Arizona feedlot in going to confinement over open lot. (Cartmell-East Central).

### 1588-A11, B1, D3, E3

### NUTRITIVE CONTENT OF HOUSE FLY PUPAE AND MANURE RESIDUE

Department of Animal Science, Colorado State University, Fort Collins.
J. S. Teotia, and B. F. Miller.
British Poultry Science, Vol. 15, p. 177-182, 1974. 1 fig., 5 tab. 8 ref.

Descriptors: *Farm wastes, *Poultry, *Nutrients, *Recycling, Metabolism, Energy, Amino acids, Proteins, Analysis, Feeds, Waste treatment, Waste disposal.
Identifiers: *Manure, *House fly pupae, Refeeding.

Fresh poultry manure was inoculated with house fly eggs and incubated. Tests were then conducted to determine the energy value and feeding potential of pupae from the common housefly Musca domestica L. and/or digested poultry manure. Results showed that pupae contain high levels of many nutrients important in poultry nutrition. Analyses showed that the pupae contained 61.4% protein and 9.3% fat. The amino acid composition of pupae was similar to that of meat-and-bone meal or fish meal and was better than soybean oil meal. Results of feeding trials showed that there was no significant difference in weight gain in pupae- fed chicks from 1 day to 4 weeks of age than with those fed soybean meal. However, chicks fed digested poultry manure showed inferior food conversion. Protein and higher fiber content of the digested manure may account for the difference. The metabolisable energy value of pupae and digested manure was found to be 10:6 and 2:4 MJ/g (2528 and 580 K cal/g), respectively. (Russell-East Central).

### 1589-A2, B1, F1

### PIERCED STEEL PLANKING SURFACING FOR FEEDLOT RUNOFF CONTROL

Water Research Institute, South Dakota State University, Brookings.
J. L. Wiersma, C. B. Gilbertson, J. M. Madden, R. E, Larson, F. L. Shapler. et. al.
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, December 11-14, Chicago, Illinois, 16 p., 17 fig., 17 ref.

Descriptors: *Feed lots, *Runoff, *Control, Waste treatment, Farm wastes, Cattle, Economics, Water pollution, Infiltration rates, Hogs, Design, Costs.
Identifiers: *Pierced steel planking, Manure.

The concept of using pierced steel planking in a dish shaped feedlot with a porous surface on a sand bed to partially treat the liquids which had been separated from the solids proved unsatisfactory. It was unsatisfactory because the waste material from the cattle combined with their hair to form an impermeable layer on the sand and this prevented vertical water movement. However, the pierced steel lot did show certain advantages over concrete lots. Some of these advantages were: the cattle adapted readily to the steel; the surface remained stable; the surface could be cleaned easily; the surface could be cleaned when concrete lots remained frozen; the lots were cooler than concrete lots during the warm months; the lots were dust free during dry seasons; and the lots could be easily remodeled by arranging the sections differently with a tractor. The price of the steel pierced lot varies as do other surfaces with each set of conditions. (Russell-East Central).

### 1590-A11,D1,D2,E2,E3,F1

### NUTRIENT RECOVERY: NEW CONCEPT IN WASTE HANDLING

P. D. Andre.
Beef, Vol. 10, No. 7, p. 74-76, March, 1974. 6 fig., 1 tab.

Descriptors: *Nutrient removal, *Farm wastes, *Waste treatment, Recycling, Water purification, Confinement pens, Model studies, Bacteria, Separation techniques, Irrigation, Fertilization.
Identifiers: *Waste handling, Refeeding.

In the near future, cattle feeders may begin to use a nutrient recovery system as an integral part of a confinement feeding building. Such a system has been developed and is currently undergoing experimentation. This system starts with raw manure and through a series of three stages removes the organic and inorganic nutrients for animals and field crops, ending up with clear water? In the first stage, 30% of the total available dry solids can be pulled out. The second stage, which can involve up to five steps, removes most of the remaining nutrients. The third stage is a water purification stage. The cost of such a system is very high, but experiments indicate that returns from the system can be considerably higher than the cost. The nutrient value of the extracted wastes appears to be very high, and a well balanced high protein feed is the result of the process? Although there are minor problems to overcome, the Corrall Nutrient Recovery System's designers are confident that it will offer substantial gains for confinement feeding. (Russell-East Central).

## 1591-A6,B1,B4,D1,D2,E2

### PNEUMATIC TRANSPORTATION OF MANURE

Manager Laboratory of Mechanization, All-Union Research Institute of Cattle-breeding, Podolsk, Moscow Region, USSR.
A. N. Shimko.
Transactions of the ASAE, Vol. 16, No. 6, p. 1170-1171, Nov.-Dec., 1973. 1 fig, 3 ref.

Descriptors: *Waste treatment, *Waste storage, Fertilizers, Nutrients, Economics, Organic wastes.
Identifiers: *Manure, *Pneumatic transporation, Holding tanks. Manure pits, Land spreading.

In Russia, the work involved in loading, unloading, and transporting manure accounts for approximately 40% of all the labor expended on farms. About one-half of this amount is required for handling manure. At the Mechanization Laboratory of the All-Union Research Institute of Cattle-breeding, a pneumatic system was designed to transport and load manure into storage structures on livestock farms of 100 to 2,000 head of cattle. This system eliminated tractors, transport units, and traffic in moving manure from barns to pits. It also provided the means to convey, receive, and store for long periods high quality organic fertilizer without the loss of nutrients. The system involves transportation of manure from barns to the manure bank. When the tank is full, it becomes pressurized to about 6 atmospheres. The manure is then sent through a pipeline and stored at the bottom of a pit. The upper layers of the pit dry and reduce odors. When needed, the top layers are removed and used for fertilizer. (Russell-East Central).

## 1592-A5, A6, B2, B4, D1, D2, D3, F1

### ANAEROBIC DIGESTERS AND LAGOONS

Oregon State University, Corvallis.
T. L. Willrich.
Unpublished paper, 1971, 3 p.

Descriptors: *Anaerobic digestion, *Lagoons, Waste storage, Waste treatment, Sludge, Municipal wastes, Odor, Groundwater pollution, Waste storage, Organic wastes, Costs.
Identifiers: Manure.

The anaerobic digester is used to treat solids and scum that are removed from municiual sewage, and it is used to treat animal manure. The anaerobic lagoon is usually used for the storage or treatment, or both, of some industrial organic wastes and animal manure. The anaerobic digester involves a closed vessel, capture of gases, heating, daily sludge removal, and continuous mixing. The anaerobic lagoon involves an open impoundment, release of odorous gases, no artificial heat, sludge accumulation, no controlled mixing. The anaerobic lagoon is an inexpensive device for the temporary storage of manure or the primary treatment of manure, or both. The limitations and advantages of the anaerobic lagoon are listed. Also recommendations for the design of the anaerobic lagoon are given. (Cartmell-East Central).

## 1593-A10, B1, D3

### DUNG BEETLES: BIOLOGICAL WEAPON AGAINST HORN FLIES

S. A. Sanchez.
The Cattleman, p. 76-77, March, 1973. 2 fig.
Descriptors: *Farm wastes, Texas, Cattle, Australia, Waste treatment, Diseases.
Identifiers: *Flies, *Manure, *Dung beetles.

A species of Afro-Asian dung beetle, Onthophagus gazella, introduced to South Texas from Australia, shows promise of helping control manure-breeding flies that affect cattle. Under optimum conditions, a cow dropping can be broken down in 24 hours through the cooperative efforts of about 50 conjugal pairs of beetles. Onthophagus appears to be able to survive winter weather and droughts. The beetle operates by working beneath the manure, breaking it down and burying it in underground tunnels. Being a night flier, it is less subject to such predators as cattle, egrets, meadowlarks, toads, and wild turkeys. It is also less apt to become an intermediate host of parasites than are day crawling insects, (Whetsone, Parker, Wells-Texas Tech University).

## 1594-A8, E2, F1

### EFFECT OF CAGED-LAYER MANURE ON PASTURE LAND

North Carolina State University, Raleigh.
D. B. Harwood, T. B. Morris, Jr., G. A. Martin, J. A. Phillips, and J. V. Gaird.
Unpublished paper, 1973, 4 p.

Descriptors: *Farm wastes, *Poultry, *Pastures, Fescues, Fertilizers, Clovers, Rates of application, Litter, North Carolina, Costs, Forage grasses.
Identifiers: *Caged-layer manure, Yield.

In 1969, the authors solicited the cooperation of Maurice and Eugene Pickler of Springdale Farms, Inc., in conducting field trials of application rates of coned caged layer manure on pasture land. The farm had been seeded to tall fescue and ladino clover several years earlier, had been generally underfertilized and overgrazed, and had become a mixed sod of species seeded and native grasses and clovers. The experimental area was divided into four plots. 600 lbs./A of 16-16-16 fertilizer was applied to Plot 1; 5 tons/A of manure from caged hens was applied to Plot 2; 10 tons/A of the manure was applied to Plot 3; and 15 tons/A of the manure was applied to Plot 4. Measurement of forage was taken at irregular intervals. Yield was increased 28, 48, and 118% by the addition of 5, 10, and 15 tons of coned cage manure on alternative years. At the low rate of application, carry-over effect was only 14% of direct effect, but at the higher application rates, carry-over effect was more than 60% as large as direct effect. At 50c/lb. of beef, the yield would be worth $30.80 per ton of manure, or, at 30c/lb. of beef, the yield would be worth $18.48 per ton of manure applied. (Cartmell-East Central).

## 1595-B3, C1, C2, C3, D1, E2, E3

### AIR DRYING OF POULTRY MANURE UNDER FULLY STEPPED CAGES IN DEEP PIT HOUSES

Durham, England.
H. A. Elson, A. W. M. King, and C. L, Benham.
Unpublished report, March, 1972, 4 p. 6 taab.

Descriptors: *Drying, *Poultry, *Farm wastes, Waste treatment, Waste disposal, Feeds, Fertilizers, Recycling, Molds, Moisture content, Bacteria, Proteins, Nitrogen, Phosphorus, Postassium, Larvae.
Identifiers: *Manure, *Deep pit houses, Slats, Refeeding.

In order to use or dispose of poultry manure, it is logical to consider drying it since this considerably reduces its mass and renders it more convenient to handle. In a search for an economical and efficient method of drying manure, trials were set up, in which slats of various widths were installed under cages. Samples of manure were taken every two months and analyzed for moisture content, molds, pathogenic bacteria, fly larvae, fertilizer and feeding values. With regard to fertilizer value, an analysis of a typical sample was: dry matter 74.1%, nitrogen 8.88%, phosphorus 2.13%, potassium 2.19%, $CaCO_3$ 5.36%. The feeding value of this sample was crude protein 25%, crude fiber 12.2%, oil 1.0%, ash 25.4%. It was concluded that this method of utilizing slats under cages to dry poultry manure had proved efficient and economical. The narrower the slat, the quicker the drying takes place; the narrower the gap the quicker the manure bridges it—preventing further drying. Subject to certain limitations, the dried material is suitable for use as a feed or fertilizer, which considerably enhance its value. (Cartmell-East Central).

## 1596-A11, D2, E3

### THE NUTRITIONAL VALUE OF HYDROLYZED POULTRY MANURE FOR BROILER CHICKENS

Division of Poultry Husbandry, Georgia University, College Experiment Station, Athens.
K. E. Wehunt, H. L. Fuller, and H. M. Edwards, Jr.
Poultry Digest, Vol. 39, p. 1057-1663, 1960. 5 tab, 17 ref.

Descriptors: *Hydrolosis, *Poultry, *Farm wastes, Performance, *Feeds, Growth rates, Litter.
Identifiers: *Nutrition, *Manure, *Broiler chickens, *Refeeding.

The objective of this study was to determine the value of hydrolyzed poultry manures as ingredients in broiler diets by obtaining a measure of the bilogical value of their protein, and by determining their unidentified growth factor activity in comparison with recognized sources of such factors. The results indicated that chicks can utilize a portion of the protein of hydrolyzed broiler litter when it is added to diets that are sub-optimal in protein. The chicks receiving supplemental protein from manure required more crude protein per gram gain in body weight than those receiving equal amounts from the other sources. Thus, on the basis of crude protein, the manures were less efficient than either soybean oil meal or the casein-gelatin combination. Based on chemical determination performed during this investigation, only about one-half of the crude protein of hen manure and slightly more than one-third of that of broiler manure existed as true protein. It appeared that autoclaved poultry manure was approximately equal to condensed fish solubles and dried distillers' solubles combined, and superior to either in supplementing corn-soybean oil meal type rations containing no other UGF supplements, as such. (Cartmell-East Central).

## 1597-A11, B1

### SPRINKLING CATTLE FOR CONTROL OF HEAT STRESS

Department of Agricultural Engineering, California University, Davis.
S. R. Morrison, R. L. Givens, and G. P. Lofgreen.
California Agriculture, Vol. 27, No. 8, p. 7-9, August, 1973. 1 fig., 4 tab.

Descriptors: *Sprinkling, *Cattle, *Control, *Heat, *Temperature, Refrigeration, Performance, Mud.
Identifiers: *Heat stress, Slotted floors, Space.

Two studies were conducted at the Imperial Valley Field Station. In one study cattle were sprinkled for 1 minute every 30 minutes when the temperature was above 80°F, or they were housed in a refrigerated barn maintained at 75°F. Results of this first experiment showed cattle cooled by either refrigeration or by sprinkling ate significantly more feed and gained weight faster than did the uncooled control cattle. However, efficiency of feed conversion was not greatly affected. The control cattle were under some degree of heat stress, as their respiratory rates and body temperatures were higher than those of animals cooled by refrigeration or sprinkling. In experiment two, both uncooled and cooled cattle consumed more feed and gained more weight when alloted 40 sq. feet per head of space than with 20 sq. feet. Other results were fairly comparable to experiment one. (Cartmell-East Central).

## 1598-A8, B1, B2, B5, C2
### POSSIBILITY OF REDUCING NITROGEN IN DRAINAGE WATER BY ON FARM PRACTICES

Department of the Interior, Bureau of Reclamation, Fresno Field Division, Fresno, California.
J. W. Williford, and D. R. Cardon.
Agricultural Wastewater Studies, 1971, Report No. REC-R2-71-11, 83 p., 18 fig., 31 tab, 23 ref.

Descriptors: *Nitrates, *Agricultural waste, *Fertilizers, Lysimeters, Sub-surface drainage, Denitrification, Ammonia, Crop production, Animal wastes, Municipal wastes, Nitrogen.
Identifiers: *San Luis Service Area, California, *Nitrogen Budget, Mineralization, Organic nitrogen, Drainage water, Farm practices.

A nitrogen balance study of the San Luis Service Area determined that the average annual nitrogen contributions from all sources other than residual soil nitrogen were approximately equal to the nitrogen removal by crops and gaseous losses. This would indicate that, although in many instances the residual-nitrates would replace some of the contributed nitrogen, especially fertilizers, animal and municipal wastes, the amount of nitrates moved to the drains would be proportional to the amounts of soluble, native nitrates in the soil. A soil sampling study at several sites throughout the area indicated that there were a wide range in the concentrations of nitrates, ammonia and organic nitrogen in the soils and subsoil. There were extremely high concentrations of nitrates in those soils located on the interfan positions between the larger streams. Fertilizer studies in lysimeters show that in medium to heavy textured soils under normal irrigation and fertilizer management practices very little nitrogen is leached to the drains. Nitrate type fertilizer contributed more nitrogen to the drainage effluent than ammonia and slow release sulfur coated urea fertilizers. It was concluded that the best possibilities to reduce nitrogen in drains by on farm practices will be to establish Farm Advisory Programs to encourage the most efficient farm management and fertilizer practices and to design drain systems to promote denitrification and reduce the area swept by the drain flow lines. (Williford-U. S. Bureau of Reclamation).

## 1599-A5, B1, F1
### RESPONSIBILITIES OF CONSULTING ENGINEERS IN PREPARING LIVESTOCK WASTE MANAGEMENT PLANS

Nebraska University, Lincoln.
W. A. Olson,
Extension Service, University of Nebraska, Lincoln, November, 1972, 2 p.

Descriptors: *Livestock, *Farm wastes, *Management, Feed lots, Design, Wells, Topographic mapping, Planning.
Identifiers: *Consulting engineers, Cost sharing, Debris basin, Holding pond.

Eleven steps were given for consulting engineers in preparing livestock waste management plans. In short, they include: (1) prepare a topographic map of existing or proposed feedlot areas; (2) prepare a topographic map showing the total land area to be used for disposal of feedlot waste; (3) prepare a design for the livestock waste management system; (4) discuss management aspects of proposed system with operator; (5) discuss with operator cost-sharing from ASCS; (6) make the operator aware of existing feedlot problems; (7) check on quality of drinking water from domestic wells; (8) include with plans completed Department of Environmental Control Forms; (9) engineer should prepare the field layout; (10) provide recommendations for sealing the debris basin and holding pond; (11) prepare written contract between the consulting engineer and operator. (Cartmell-East Central).

## 1600-A8, C2, E2
### ACCUMULATIVE EFFECTS OF MANURE AND N ON CONTINUOUS CORN AND CLAY SOIL. 1. GROWTH, YIELD, AND NUTRIENT UPTAKE OF CORN

Department of Plant and Soil Science, Vermont University, Burlington.
J. L. McIntosh, and K. E. Varney.
Agronomy Journal, Vol. 64, No. 3, p. 374-379, May-June, 1972. 3 fig., 8 tab, 12 ref.

Descriptors: *Farm wastes, *Nitrogen, *Corn (Field), *Soils, *Growth rates, *Nutrients, Physical properties, Chemical properties, Potassium, Magnesium, Calcium, Moisture, Rainfall.
Identifiers: *Manure, *Yield, Mineral composition.

The objectives of the study were to study the effects of continuous corn and manure and N treatments on the physical and chemical properties of the soil and on the growth, yield, and mineral composition of the corn plants over a period of at least 5 years. The results are reported in this paper. During years of normal or less than normal rainfall, manure application significantly increased yields of corn grain and stover. During relatively wet years, manure had no beneficial effect on corn growth and yield. Manure treatments increased percentage K by as much as 0.30% in the corn ear leaves but decreased Ca and Mg. Manure had little effect on percentage N and P. In a wet year, manure reduced N from 2.72 to 2.44% when averaged over all treatments of N. Chemical analysis of small plants showed the same trends as did analysis of ear leaves. Manured plots were slightly but consistently higher in soil moisture. Small differences of about 1% were measured when the soil was near saturation (43% moisture). Differences of 2.5% were measured 1 week later when the soil was near 30% moisture. (Cartmell-East Central),

## 1601-B2, B4, C2
### SUBFLOOR MONITORING OF SHADY GROVE DAIRY LIQUID MANURE HOLDING POND

Farm Advisor, California University Extension Service, San Bernadino County.
J. C. Oliver, W. C. Fairbank, J. L. Meyer, and J. M. Rible.
California Agriculture, Vol. 28, No. 4, p. 6-7, April, 1974. 1 fig., 6 tab.

Descriptors: *Monitoring, *California, *Dairy industry, *Liquid wastes, *Sealants, *Seepage control, Analysis, Chemical properties.
Identifiers: *Subfloor, *Manure *Holding pond.

Subfloor monitoring of the Shady Grove Dairy liquid manure holding pond was begun in June, 1972, with the installation of duplicate tensiometer cups at 2, 4, 6, 8, and 9 ft. below the pond floor. Extracts for analysis were collected weekly from ceramic cups for the first six weeks after the pond was filled with manure water. Chemical analyses of soil solution extracts from beneath the pond were given. This subfloor monitoring technique established that the dairy waste pond had become effectively sealed. The soil solution analysis as compared with original soil analysis data, leads to the conclusion that sealing of ponds takes place essentially in the upper 6 ft. of soil in a pond bottom. (Cartmell-East Central).

## 1602-A6, A7, A10, A11, B1
### SPRINKLING FOR DUST SUPPRESSION IN A CATTLE FEEDLOT

Agricultural Experiment Station, Department of Agricultural Engineering, California University, Davis.
J. J. Carroll, J. R. Dunbar, R. L. Givens, and W. B. Goddard.
California Agriculture, Vol. 28, No. 3, p. 12-14, March, 1974. 4 fig.

Descriptors: *Sprinkling, *Dusts, *Feed lots, *Cattle, Temperature, Humidity, Dew point, Performance, Odor, Mortality, Morbidity, California.
Identifiers: Flies.

This report summarizes an investigation of the effectiveness of sprinkling open, unpaved, feedlot cattle pens for dust control, and the effect of sprinkling on the temperature and relative humidity. One sprinkled feedlot and one unsprinkled feedlot, located in the Imperial Valley of California, were studied. A program of sprinkling the pens for 2 hours, beginning at 1 pm PDT and again for 1½ hours beginning about 5 pm PDT, should reduce the total dustiness by at least half. Sprinkling appears to reduce the maximum temperature reached for the day less than 10°F while raising the ambient relative humidity by not more than about 10%. No deleterious effects on animal performance, morbidity, or mortality resulted from sprinkling. No increase in fly or odor problems could be traced to sprinkling. (Cartmell-East Central).

## 1603-B1, B4
### DRINKING WATER CONTROL IN DEEP PIT LAYING HOUSES

Agricultural Experiment Station, Maine University, Orono.
F. V. Muir, G. B. Jaeger, and H. C. Whelden, Jr.
Research in Life Sciences, Vol. 20, No. 4, 4 p., September, 1972. 3 tab, 3 ref.

Descriptors: *Poultry, *Water, *Control, Waste storage, Farm wastes, Flow control, Waste disposal.
Identifiers: *Water supply, *Deep pit laying houses, *Flow-through trough.

Commercial poultry houses designed with a deep pit provide a manure storage area which permits greater flexibility in manure disposal alternatives. Manure can be allowed to accumulate in the pit for a time period in excess of one year. The method of watering the layers in the houses has been an intermittent flow-through system. Three trials were conducted to determine the consistency of flow rates from flow control valves; to measure flow rates from ¾ gallon per minute flow control valves installed in varying locations in a 4-row double deck, deep pit cage system; and to measure the time required for water to flow from the inlet to the overflow end of trough waterers. The results indicated that flow control valves can be used in commercial poultry houses to equalize the flow rate into the individual trough of an intermittent flow-through watering system. (Cartmell-East Central).

## 1604-A3, A5, A8, C2, E2
### POLLUTIONAL ASPECTS AND CROP YIELDS RESULTING FROM HIGH MANURE APPLICATIONS ON SOIL

Agricultural Engineering Department, Nebraska University, Lincoln.
O. E. Cross.
Presented at 67th Annual Meeting of American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4059, 29 p., 21 fig., 1 tab, 13 ref.

Descriptors: *Water pollution, *Rates of application, *Soils, *Farm wastes, *Waste disposal, Runoff, Groundwater pollution, Feed lots, Cattle, Nitrates, Irrigation, Sodium, Potassium, Electrical conductance.
Identifiers: *Crop yields, *Manure, Land spreading.

Beef cattle manure was applied on the test sites at levels of 0, 40, 80, and 160 tons per acre for four years. The sites were plowed at depths of 4, 8, and 12 inches. Crops were planted on the sites at three plant densities: "low", "medium", "high". The crops were then irrigated, and data was gathered concerning crop response, pollution of underground water supply, and pollutional potential from surface runoff. It was found that plant densities or plow depth had no effect on crop yield, and over the four year period crop yield had not decreased on sites where manure was added. The underground water appeared to have retained its potable quality throughout the test. Nitrogen displacement in the runoff exceeded the potable water allowable of 10 ppm only during the first 90 minutes of irrigation on heavily manured sites. The sodium concentration of the runoff never exceeded the maximum for potable water, but it is acceptable to be reused for irrigation. Also electrical conductance was never above Water Quality Standards. Results indicate that runoff from manured areas can be reused as irrigation water. (Russell-East Central).

### 1605-A6,A11,B2,B4,D1,D3,E2

## SWINE WASTE MANAGEMENT SYSTEMS

Agricultural Engineering Department, Purdue University, West Lafayette, Indiana.
B. Horsefield, J. Gottbrath, and J. Kadlec.
Presented at the 1973 Winter Meeting of the American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, Paper No. 73-4517, 33 p., 9 fig., 10 tab, 15 ref.

Descriptors: *Hogs, *Farm wastes, *Waste treatment, *Management, *Evaluation, Costs, Lagoons, Confinement pens, Economics, Waste storage, Separation techniques, Transfer, Transportation, Waste disposal, Odor, Water pollution, Irrigation, Performance.
Identifiers: Oxidation ditch, Slatted floors, Collection, Land disposal.

Five unique waste handling systems for confinement finishing hogs were studied and were compared with two common systems. The five systems were: (1) a deep pit with wood slats and earth bottom; (2) partial wood slats, a shallow pit and a two-stage lagoon; (3) full wood slats with a shallow pit and lagoon; (4) a solid concrete floor with flushing and a two-stage lagoons; and (5) partial slats and air diffusion oxidation. The two common systems were: (A) concrete slats and concrete pit; and (B) concrete slats and pit with oxidation ditch and outside storage. Both cost and noncost factors were taken into consideration. The costs ranged from $.75 to $3.89 per head produced if the nutrient value of the wastes were ignored. (Russell-East Central).

### 1606-A1, E3, F2

## CONTROL OF POLLUTION FROM ANIMAL FEEDLOTS AND REUSE OF ANIMAL WASTES

Committee on Governmental Operations.
93rd Congress, 2nd Session, House Report No. 93-1012, 68 p., 1 fig.

Descriptors: *Water pollution, *Control, *Feed lots, *Farm wastes, *Livestock, Legal aspects, Permits, Regulation, Fertilizers, Fuels, Recycling, Waste treatment, Waste disposal, Cattle.
Identifiers: *Pollution, *Reuse, Environmental Protection Agency.

This report looks at the Federal Government's efforts to control pollution from animal feedlots by more efficient management of wastes and by encouragement of their reuse as fertilizer and fuel. It discusses the nature of feedlot pollution from feedlots, and the current EPA policies for control. Also discussed is the pollution problem versus the administrative problem. A lengthy portion deals with permit requirements for point source pollutors. Three appendices discuss the types of animal feedlots, the EPA's authority to exclude point sources from the permit program, and a photograph of a beef cattle feedlot, respectively. Supplemental views of Hon. John C. Culver and dissenting views of Hon. Charles Thone are included. (Russell-East Central).

### 1607-A11,B3,C1,C2,D2,E3,F1, F2

## $500,000,000, MARKET—IF FDA SAYS OKAY

C. Cooper.
Egg Industry, Vol. 6, No. 7, p. 15, 18, 20-21, July, 1973. 3 fig.

Descriptors: *Farm wastes, *Poultry, *Feeds, *Recycling, *Waste treatment, Moisture content, Proteins, Nutrients, Costs, Performance, Dehydration, Drying.
Identifiers: *Dried poultry waste (DPW), Food and Drug Administration, Pasteurization.

A half-billiion dollar market for DPW (dried poultry waste) as a feed ingredient may be just around the corner if the Food and Drug Administration yields to pressure from many industry sources, and on Capitol Hill, to recognize it as a safe and effective feed additive. Major roadblock to final FDA sanction is the promise of that intense fight from consumer groups. Various other countries are already utilizing DPW as a feed ingredient. Smaller eggmen will have the option of purchasing smaller driers and processing their own wastes or selling the raw manure to a bigger operator. Most scientists agree that the lower the moisture content of the raw manure when it's fed into the drier, the better. But, they also agree that if poultry manure is left in the houses for more than three days, the protein value of DPW deteriorates, bringing down with it the expected selling price. Reducing the cost of producing a dozen eggs by one per cent of feed cost, through quality control in the feed mill, can mean a $17.3 million dollar savings to the egg industry. (Cartmell-East Central).

### 1608-B2, D1

## SETTLING BASIN DESIGN FOR RACEWAY FISH PRODUCTION SYSTEMS

Agricultural Engineering Center, Georgia University, Athens.
J. L. Chesness, W. H. Poole, and T. K. Hill.
Presented at the 67th Annual Meeting of American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-5005, 13 p., 3 fig, 5 tab, 8 ref.

Descriptors: *Settling basins, *Design, *Organic wastes, *Fish, *Sedimentation, Recirculated water, Model studies, Effluent, Analysis.
Identifiers: Raceway fish production systems, *Fish wastes.

A new type of fish production system is a flowing water culture of fish in a recirculating earthen raceway. This system produces substantial amounts of fish, but if production in this closed-loop system is to continue, techniques must be found for the removal of waste products. This study was undertaken to: (1) determine the quantity of solids and the settling characteristics of suspended solids; and (2) design and test a settling basin for the removal of these solids. A trapezoidal-shaped settling basin was designed. Field evaluations showed that the basin would remove about 48% of the filterable solids. This was 82% of the predicted removal efficiency, but only 6% of the total organic solids would be removed by sedimentation. This study indicates that effective removal of waste organics in warm water fish culture recirculating raceway systems cannot be attained by physical sedimentation alone. (Russell-East Central).

### 1609-A6, A13, B2, B3, E2

## DEVELOPMENT OF AN ORGANIC WASTE SLURRY INJECTOR

Department of Agricultural Engineering, Colorado University, Fort Collins.
R. C. Gold, and J. L. Smith.
Presented at Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, Paper No. 73-4529, 12 p. 6 fig., 15 ref.

Descriptors: *Farm wastes, *Organic wastes, *Waste disposal, *Slurries, *Injection, Irrigation, Odor, Aesthetics, Economics, Ground water, Runoff, Soil analysis, Insects.
Identifiers: *Land spreading, Pollution, Deep plowing.

Organic waste disposal methods have changed little over the past several decades. However, these usually create aesthetic and pollution problems which have resulted in an attempt to find new and better ways to dispose of organic wastes. The presence of organic matter and some plant nutrients makes the idea of recycling organic wastes to the soil very desirable. The four usual methods for returning materials to the soil are irrigation, surface spreading, deep plowing or burial, and shallow plowing or injection. Since surface application creates problems, experiments were conducted using a slurry injection system. This type of system offers these advantages: (1) it is inexpensive; (2) it is capable of handling large volumes of wastes; (3) it eliminates odors, visibility, and aesthetic pollution problems; (4) it can be used in any part of the country with sufficient storage capacity for cold weather; (5) it can be operated by one person; and (6) the wastes are recycled and their benefits are not lost. (Russell-East Central).

### 1610-B1, B4, E2, F1

## TAILOR MADE CONFINEMENT BARN

Managing Editor of BEEF.
B. Fleming.
Beef, Vol. 10, No. 7, p. 8-9, March, 1974. 4 fig.

Descriptors: *Farm wastes, *Confinement pens, *Management, Fertilizer, Design, Oxidation lagoons, Lagoons, Costs, Ventilation, Insulation, Waste disposal, Waste storage, Odor.
Identifiers: *Barns, Land spreading, Slats.

A confinement barn operation should fit a feeder's personal needs. Lee and Roy Stoll had that in mind when they designed their own confinement barn. It consisted of a 256 ft. long barn. The south side of the barn was always open. The cattle were fed by a 250 ft. belt feeder which ran down the middle of the building. The manure handling system consisted of an eight ft. deep pit system. The manure was then reclaimed as fertilizer at an estimated savings of about $23 per acre. Other unique arrangements in the barn were varied pen size and slats for the background lot. The Stolls eliminated drafts by using wall-like dividers and insulation. The manure pit was eight ft. deep, but only about two feet of that was below grade. The rest was built above ground and then fill dirt was added. The stall operation is a carefully matched setup, and is tailored for their specific operation. (Russell-East Central).

### 1611-B2, C2, D3, F1

## METHODS OF REMOVING NITRATES FROM WATER

Robert S. Kerr Research Center, Ada, Okla.
P. P, St. Amant, and L. A. Beck.
Journal of Agriculture and Food Chemistry, Vol. 18, No. 5, p. 785-788, September-October, 1970. 1 tab, 7 ref.

Descriptors: *Nitrates, *Water, *Algae, *Bacteria, *Denitrification, *Desalination, *Nitrogen, *Nitrates, Oxidation, Costs, Tile drainage, Osmosis, Electrodialysis, Proteins, California, Filters.
Identifiers: *Algae stripping, Pond.

Due to salt accumulation in the water collected by tile systems in the California San Joaquin Valley, it is necessary to dispose ultimately of this water. Reports show that nitrogen, primarily in the nitrate form, is a serious potential pollutant. Two basic methods of nitrogen removal are being evaluated at the Agricultural Waste Water Treatment Center. These methods are termed bacterial denitrification and algae stripping. Two methods of bacterial denitrification are being evaluated: pond denitrification and filter denitrification. Desalination of the tile drainage is also used. The report has explanations of each method. Also, the efficiency of each method is discussed. Land requirements for these three systems will vary greatly. Initial cost estimates for nitrogen removal by these three biological systems are nearly the same—around $25 to $30 per million gal. based on an average influent nitrate-nitrogen concentration of 20 mg per 1. (Cameron-East Central),

### 1612-A1, A6, A11, B3, E3, F1

### CAN WE REFEED FEEDLOT WASTES?

E. Wilborn.
Progressive Farmer, Vol. 89, No. 3, p. 58, March, 1974. 1 fig.

Descriptors: *Recycling, *Farm wastes, *Feed lots, Cattle, Livestock, Performance, Costs, Odor, Waste treatment, Waste disposal, Feeds.
Identifiers: *Refeeding.

Now research is proving that feedlot wastes can be an important source of livestock feed. Sevetral important developments on the subject were reported at the winter meeting of the American Society of Agricultural Engineers in Chicago. Beef cows can be trained to eat pelleted feedlot manure mixed with barley as a supplement to dry pasture feeding. Three groups of pregnant Hereford cows were fed on dry range for 84 days. One group's diet was supplemented with pelleted cottonseed meal; one with a pelleted mixture of 75% feedlot manure and 25% barley; and one group received no diet supplement. Cows given the manure-barley pellet had a higher body weight than cows given the cottonseed meal supplement. Costs for refeeding operation were lower than for a standard feedlot operation but initial investment and labor for the refeeding operation were higher. Odor reduction and solving of environmental pollution problems are two benefits. (Cartmell-East Central).

### 1613-A11, E3, F1

### SOME REFLECTIONS ON DRIED POULTRY WASTE

California University, Riverside.
M. H. Swanson.
Poultry Digest, Vol. 33, No. 385, p. 118-121, March, 1974. 2 fig., 13 tab.

Descriptors: *Farm wastes, *Poultry, *Drying, *Recycling, Fertilizers, Fuels, Performance.
Identifiers: *Refeeding, Dried poultry waste (DPW).

Agricultural and food processing wastes, including those from poultry, have three principal alternative uses: (1) as fertilizers and soil amendments; (2) as feed ingredients for recycling through livestock and poultry; (3) as sources of fuel (energy). Poultry wastes as fertilizers and fuel are discussed briefly. A more profitable potential for utilization of poultry waste is the recycling of the product as a feed ingredient. Complete composition of dried poultry waste is given. Modification in the composition of poultry droppings occurs during the holding period prior to artificial drying and during the drying period itself. Indigestible components are rendered digestible through bacterial action and chemical breakdown. Exposure of the product to too high a temperature reduces its nutrient value. Total nitrogen and crude protein values for DPW are high. DPW is a low energy product. When DPW was fed to laying hens, egg size and shell thickness was reduced with increasing levels of DPW. But the addition of DPW did produce higher albumen quality. The use of dried poultry waste in some poultry rations may result in reduced costs; still greater savings can be realized by using DPW in ruminant rations. (Cartmell-East Central).

### 1614-A2, C2

### WATER QUALITY OF STORM RUNOFF FROM A TEXAS BEEF FEEDLOT

Abraham Baldwin Agricultural College, Tifton, Georgia.
G. G. Wise, and D. L. Reddell.
Presented at 66th Annual meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-441, 23 p., 9 fig., 5 tab, 23 ref.

Descriptors: *Water quality, *Storm runoff, *Texas, *Cattle, *Feed lots, Measurement, Sampling, Drainage area.

A study of feed lot runoff was conducted for nine months on a 10,000 head feed lot. Over 250 runoff samples were collected from 11 natural storms on two drainage areas. Approximately .5 inch of rainfall was generally required to initiate runoff. Relationships between volatile solids, total solids, and chemical oxygen demand were established. Storm pattern and size had little effectt on the average concentration of a chemical element. Chemical oxygen demand, phosphorus, and Kjeldahl nitrogen followed the variations in total solids concentrations. Potassium, sodium, and chloride and filterable solids were not related to the sediment load. Most chemical constituents' concentrations were greater from area one than from area two, probably because of a greater slope at area one. (Frantz-East Central).

### 1615-A11, B1, F1

### WILL A CONFINEMENT BARN PAY?

Beef, Vol. 9, No. 8, p. 3-5, April, 1973. 4 fig.

Descriptors: *Confinement pens, *Economics, *Feedlots, Cattle, Costs, Farm wastes.
Identifiers: *Open lots.

Much controversy has arisen among beef producers over the economics of confinement feeding. Some say that open lots are cheaper and and just as good, while others insist that confinement is more profitable. The proponents of the open lot say that open lots are as productive as confinement if they are designed properly and not overloaded. In a comparison between confinement and open lot we see that: (1) Feeding time is shorter in confinement; (2) The handling of the cattle is easier inside; (3) It is a toss up between the manure handling; (4) The open lot is much cheaper to build; (5) Surprisingly, it takes less upkeep to keep the building in good shape than it does the outside; (6) Insurance is cheaper for the outside arrangement; (7) It takes less labor inside; (8) Health is better inside; (9) Marketing programs can be planned better inside; and (10) Space is better conserved with a building than with an open lot. Both systems have advantages and disadvantages, but the success is dependent on individual needs and circumstances. (Russell-East Central).

### 1616-A11, B1

### WASTE MANAGEMENT IN FIVE BEEF HOUSING SYSTEMS

West Central Experiment Station, University of Minnesota, Morris.
L. K. Lindor, K. A. Jordan, R. E. Smith, H. E. Hanke, et. al.
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, Paper No. 73-4543, 12 p. 15 tab.

Descriptors: Waste treatment, *Cattle, *Confinement pens, *Performance, Farm wastes, Waste storage.
Identifiers: *Waste management, *Housing systems, Cold barns, Warm barns.

Production data was gathered in five beef housing systems. The data concerned animal wastes, environments, average daily gain, and feed efficiency for 680 head of 425 pound hereford steers fed over a two-year period. Housing systems were compared. It was found that there was a manure build-up on top of the slats in the cold slat barn during extreme winter weather. The manure pit froze in the cold barn soon after the outside temperature dropped below 32 degrees. Before pumping the pits, it was necessary to agitate 6 to 8 hours to prevent solids from building up on the pit floor. It was also found that an 8 ft. deep pit was adequate for feeding out 425 pound steers to market weight. The sloping floors in the scrape barn aided movement of waste into the scrape ally. It was concluded that the environmental modification provided by the heavily insulated warm barn might be superfluous. (Russell-East Central).

### 1617-A6, A7, B1

### PREVAILING WINDS IN FEEDLOT SITE SELECTION

Texas Agricultural Extension Service, Texas A & M University, College Station.
J. M. Sweeten.
Prepared for publication by Regional Extension Project for Feedlot Waste Management through the Great Plains Extension Feedlot Committee, July 9, 1973, 6 p. 3 fig.

Descriptors: *Feedlots, *Sites, *Wind, *Odor, Precipitation (Atmospheric), Wind velocity, Cattle.
Identifiers: *Site selection, Climatic patterns, Wind direction, Buffer zone.

Confined feeding of cattle in feedlots inevitably leads to the production of odor. Consequently, the most important element of a feedlot odor abatement consists of judicious site selection, which involves a study of local climatic factors to minimize the probability of odor drift into nearby population centers or closest neighbors in the direction of least probability of wind occurance. The optimum direction can be determined from published "wind rose" diagrams or from tabular wind direction data. An alternative objective in feedlot site selection, where sufficient data is available, is to minimize the probability of both a rainfall event and a specified wind direction occurring simultaneously. If feedlot odors are minimized during the most critical periods of adverse moisture and temperature, the wind speed factor is probably less important than wind direction considerations. (Russell-East Central).

### 1618-A11, C2, E3, F1

### THEY BEAT THE HIGH COST OF PROTEIN WITH PLS

B. Johnson.
Progressive Farmer, Vol. 88, No. 11, p. 44-45, November, 1973. 2 fig.

Descriptors: *Costs, *Proteins, *Feeds, *Poultry, *Litter, *Silage, Cattle, Performance, Recycling, Waste disposal.

Tests are being made by Graham farm in Lexington, on a new kind of feed for dairy cattle called Poultry Litter Silage (PLS). The Grahams, using broiler litter given them from their neighbors, feed heifers and steers proteins that cost about one-twentieth as much as soybean meal. Here's how they figure it. Soybean meal with 38% disegtible protein sells for $300 a ton or 39 cents per pound (digestible). PLS is 14% digestible and costs $5 a ton. This is 2 cents per pound of digestible protein. Making this new feed is an art which must be carefully tested to assure safety. Cattle fed PLS gained weight satisfactorily and calved with no ill effects. Quality and taste of the meat seem to be good. Since the FDA doesn't sanction the feeding of poultry manure to other animals, cattle owners are liable if any harmful residues or contaminants can be traced back to their feeding operations. With PLS costing only one-twentieth of soybean meal cost, the Grahams, and many others believe the present evidence makes the risk of feeding PLS worth taking. (Cameron-East Central).

## 1619-A8, B3, E2
### FERTILIZER VALUE OF DAIRY LOT MANURE
J. M. Rakes, Q. Hornsby, and G. Barr.
Arkansas Farm Research, Vol. 23, No. 1, p. 8, January-February, 1974. 2 tab.

Descriptors: *Fertilizers, *Dairy industry, *Feed lots, *Farm wastes, *Waste disposal, Sampling, Analysis, Chemical properties, Nutrients, Forage grasses.
Identifiers: *Manure, Yield.

A study was undertaken at the Maine Experiment Station utilizing dairy lot manure as fertilizer. Two methods of manure handling were compared: scraping the manure into a pile and loading with a front-mounted tractor loader, or loading from a concrete ramp. Fresh dairy lot manure was applied at two rates of wet material—10 tons versus 100 tons per acre—on 1 acre plots in a field. The material was incorporated into the soil, and Boone orchardgrass and Victoria alfalfa were sown in the fall. Three types of soil were represented in the field. Yields were recorded and proximate analyses were made of the forage produced. Yield was consistently higher with the high level of manure application in all three cuttings. The data from this study suggest that, if cattle wastes are available, increased yields can be obtained by a high rate of application, balanced with limited commercial fertilizer. (Cartmell-East Central).

## 1620-A11, B3, D1, D2, F3
### PROTOTYPE OF A BROILER CAGE SYSTEM
L. D. Andrews, G. S. Nelson, and G. C. Harris, Jr.
Arkansas Farm Research, Vol. 22, No. 1, p. 9, January-February, 1973. 3 fig.

Descriptors: *Farm wastes, *Poultry, Performance.
Identifiers: *Cage system, *Broilers, Cross auger, Feather follicles, Dropping boards.

Interest in caged broiler housing has been growing for several reasons: (1) the broilers may be removed from cages to a transport truck with a minimum of manual labor; (2) more broilers can be reared in a given space; (3) no litter is required; (4) manure is more easily removed; (5) less clean-up is needed between growouts; (6) heating costs are lower; (7) debeaking may not be necessary; (8) there is less bruising by catching crews; and (9) feed conversion and weight gain may be improved. Also, the growth rate of caged broilers is comparable to that of floor-reared birds. Within this four-tiered cage system is an automated feeding system, heating cables, and fans and scrapers which remove manure from the dropping boards beneath the cages. The manure is removed from the building by a cross auger. Among disadvantages are brittle bones, infected feather follicles, breast blisters, a high investment cost, and difficulty in observing birds in the cages. Finding a way to reduce these defects is the next step in perfecting caged broiler production. (Russell-East Central).

## 1621-A6,D1,D2,D3,E3,E4
### SOLUTIONS FOR FEEDLOT ODOR CONTROL PROBLEMS—A CRITICAL REVIEW
Office of Engineering Analysis Control Systems National Environmental Research Center, Research Triangle Park, North Carolina.
R. M. Bethea.
Journal of the Air Pollution Control Association, Vol. 22, No. 10, p. 675-773, October, 1972. 1 tab, 52 ref.

Descriptors: *Feed lots, *Odor, *Control, *Air pollution, *Farm wastes, *Waste treatment, Poultry, Hogs, Cattle, Livestock, Management, Costs, Feeds, Recycling, Oxidation, Analysis Measurement.
Identifiers: Refeeding, Ozonation Incineration, Gas washing and scrubbing.

This critical review begins with a description of the air pollution and odor control problems associated with animal feedlots and poultry houses. A brief description is given for dairy odors, poultry odors, swine odors, and cattle odors. Prevention of the release of odoriferous compounds would be the most efficacious long-range solution to agricultural odor control problems. The elimination of odors by incorporating humic acid into the feed ration appears to offer a promising possibility as a control technique for cattle, swine, and sheep feeding operations. Other methods of odor control that are discussed in detail with comparative cost and effectiveness data are: odor reduction by recycle feeding, odor reduction resulting from improved waste handling procedures, odor control by chemical reaction, odor control by ozonoation, odor control by gas washing and scrubbing, and odor elimination by thermal and catalytic incineration. Discussion and recommendations for future research are presented. (Cartmell-East Central).

## 1622-B3,D1,D2,D3,E3,E4
### THE DISPOSAL OF CATTLE FEEDLOT WASTES BY PYROLYSIS
Midwest Research Institute, 425 Volker Boulevard, Kansas City, Missouri.
W. Garner and I. C. Smith.
Environmental Protection Agency Report Number, EPA-R2-73-096, January, 1973. 99 p. 15 fig. 9 tab.

Descriptors: *Recycling, *Qualitattive organic separation, *Gas condensation, *Farm wastes, Cattle, *Waste treatment, *Waste disposal, Fuels.
Identifiers: *Pyrolysis, *Feedlot waste, *Economic alaysis.

Beef cattle( steer) manure was obtained from a source that was free of soil contamination, and subsequently dried and pulverized. Replicate batch pyrolyses were carried out in stainless steel, glass, and iron tubes utilizing axial flow, at various levels of elevated temperature, and at atmospheric and lower pressures. Exhausts were carried by inert gas to traps and condensors. Qualitative separations and extractions were performed to determine the presence and quantity of various gases, ash, tar, and organics. Many constituents were extracted, but in such small quantities that their value may not pay for the cost of pyrolyzing. Larger scale pyrolyzing units should be tested to either confirm or disprove. (D. F. Anderson-Environmental Protection Agency, OR&M).

## 1623-B1, B4, D1, E2
### DEWATERING BOVINE ANIMAL MANURE
Department of Agricultural Engineering, Pennsylvania State University, University Park.
H. D. Bartlett, R. E. Bos, and E. C. Wunz.
Presented at 1973 Annual Meeting of the American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-431, 26 p. 5 fig, 11 tab, 18 ref.

Descriptors: *Farm wastes, *Dewatering, *Cattle, *Waste treatment, *Waste disposal, *Waste storage, Slurries, Irrigation, Nutrients.
Identifiers: *Manure, Fibers,

Research was conducted to develop methods of dewatering bovine manure and determine the properties of the resulting fibrous and liquid components. Methods investigated were: stationary screens (hydrosieve), vibro-energy rotary screen (sweco), pressure filtration (d'Arcy equation), porous belt with press-rolls, perforated-shell cone centrifuge, and perforated-shell screw conveyor. Results of the dewatering methods are given and the fibrous and liquid components are analyzed. The liquid contained most of the nutrient value, with nearly half of the nutrients in the particle size range smaller than 325 U.S. Mesh. The chemical oxygen demand was approximately the same for the fibrous component and for the filtrate. Dewatering of manure would allow the liquid to be stored in earthern ponds for later use for crop irrigation. The fibrous solid could then be stockpiled without seepage, odor, or fly problems. (Frantz-East Central).

## 1624-B2
### DRAINAGE SYSTEMS IN MILKING CENTERS
Food and Agricultural Engineering Department, Massachusetts University, Amherst.
R. G. Light.
Presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-414, 11 p. 3 fig.

Descriptors: *Drainage systems, *Dairy industry, *Design, Farm wastes, Waste treatment, Slopes, Construction.
Identifiers: *Milking centers.

The design and construction of milking center floor drainage systems are often mishandled, resulting in continuing problems for the operator such as water ponding on floor surfaces, continuously wet floors, and excessive time in clean up after milking. These problems can be avoided by proper attention to required elevations at the site in advance of construction and by considering the following points: installation of piping of proper material, size and slope; properly trapped and vented drains; advance study of external manure and waste treatment requirements before construction; proper curbs, thresholds or elevation differences at door openings to control flow of floor wash water; slope rates of ¼-½ inch per foot for all floors subject to washing; and other structural designs which allow visual check of equipment malfunction, storage and reuse of milk room wash water, and lift stations for transferring wastes to treatment systems (if needed). (Lee-East Central).

## 1625-B2, B4, B4, C2, D3
### TENTATIVE CRITERIA FOR DESIGN, CONSTRUCTION AND OPERATION OF THE BATCH TYPE PASVEER OXIDATION DITCH SYSTEM FOR THE TREATMENT OF ANIMAL WASTES
Department of Agricultural Engineering, Purdue University, Lafayette, Indiana.
A. C. Dale.
Unpublished Paper, February 15, 1968, 20 p. 30 fig, 2 tab, 20 ref.

Descriptors: *Design, *Construction, *Operations, *Oxidation lagoons, *Farm wastes, *Waste treatment, Aeration, Digestion, Aerobic bacteria, Anaerobic bacteria, Oxygen, Odor, Volatility, Biochemical oxygen demand, Nitrates, Nitrites, Temperature, Water pollution.
Identifiers: *Batch-type oxidation ditch, Facultative bacteria, Continuous treatment system.

A continuous oxidation ditch was developed by the Research Institute for Public Health Engineering, TNO, The Netherlands, as a low-cost method for purifying sewage emanating from small communities. The system is a modified form of activated sludge process and may be classified in the extended aeration group of odorless aerobic treatments. For either batch or continuous oxidation ditches to work satisfactorily, an aerator is used to "beat" oxygen into the waste to support the growth of bacteria and to hold the solids in suspension. Unlike the continous system, wastes are dumped into the batch oxidation ditch periodically and the aerator is not run continuously. The batch-type ditches reduce dry matter by about 40 to 50% by converting organic matter into carbon dioxide and water. The ditch releases some nitrogen but converts most of it into nitrites and nitrates. The pit (ditch) storage time may be increased by 80 to 90% provided effluent level can be controlled and oxygen transfer is possible at the greater suspended solids content. The oxidation ditch also concentrates the minerals and salt, by about 70 to 90% in the batch process. The design and operation of the oxidation ditch system is discussed in this report. (Cameron-East Central).

### 1626-B2, B3, B4, D1, D3, F5, F6

### MANURE HANDLING SYSTEMS FOR THE FUTURE

Associate BEEF Editor.
B. Eftink, and L. Searle.
Successful Farming, Vol. 72, No. 1, p. 26-29, January, 1974. 11 fig.

Descriptors: *Farm wastes, *Waste treatment, *Waste disposal, *Recycling, Lagoons, Oxidation lagoons, Waste storage, Fish farming, Economics, Costs.
Identifiers: *Manure, *Future, Composting.

Most research efforts are incorporating the use of manure as an asset instead of a liability. The future promises that manure disposal will be designed to make it pay for itself and, in some cases, profitably. There are many methods for manure disposal, and this issue outlines some of them. They are: (1) Composting manure and selling it; (2) Recycling the liquids and treating manure; (3) Using treatment tanks to decompose manure; (4) Using a hog manure supplement; (5) Piping manure underground to a storage tank; (6) Screening out the solids; (7) Using an oxidation ditch; (8) Storing manure above ground; and (9) Growing fish in manure lagoons. Some of these nine methods of manure handling are now being used, while others are futuristic. Some will prove to be useful and economical, and some will be impractical. The positive approach of researchers and private entrepreneurs to manure disposal is both enterprising and reassuring. (Russell-East Central),

### 1627-C1, C2, D3

### ANAEROBIC-AEROBIC LAGOON TREATMENT OF DAIRY MANURE WASTES

Environmental Engineering Section, Engineering Research Division, Washington State University, Pullman.
D. E. Proctor.
Environmental Protection Agency Report No. EPA 660/2-74-030, May, 1974, 47 p. 10 fig, 7 tab, 6 ref.

Descriptors: *Aerobic treatment, *Anaerobic digestion, *Farm lagoons, *Dairy industry, *Farm wastes, Foam separation, Harvesting of algae, Waste treatment.
Identifiers: Dairy manure, Pacific Northwest, Washington State University, Anaerobic lagoons.

The removal of manure from dairy cattle confinement areas by improved hydraulic flushing techniques was attempted in conjunction with an attempt to treat the resulting manure slurry in an anaerobic lagoon and activated sludge process. Algae cells were allowed to propagate in the activated sludge process effluent in an attempt to then harvest the cells and accomplish nutrient removal as a final polishing step. While manure could be hydraulically moved by high velocity flushing jets, it resulted in a slurry that was too thick to flow by gravity to catch basins within the cattle confinement areas. The anaerobic lagoon-activated sludge process sequence did accomplish overall pollutional strength reductions as high as 90%. The activated sludge process effluent was still too high in organic strength, color, and nutrients to be discharged to surface waters, however. Dissolved air flotation of algae cells produced in shallow propagation ponds was ineffective. (Boydston-EPA, PNERL, NERC, Corvallis, Oregon).

### 1628-A2, A5, A6, A8, B2, B3, E2

### NEBRASKA ANIMAL WASTE RESEARCH

United States Department of Agriculture, Agricultural Research Service, Lincoln, Nebraska.
T. M. McCalla,
Proceedings, Workshop on Livestock Waste Management, Ft. Collins, Colorado, Great Plains Agricultural Council Publication 56, p. 18-28, 1972. 47 ref.

Descriptors: *Farm wastes, *Research and development, *Nebraska, *Feed lots, Runoff, Crop production, Costs, Management, Facilities, Odor, Terracing, Effluents, Water chemistry, Hydrology, Nitrates, Caissons, Waste disposal, Groundwater, Hydrology.
Identifiers: Loading rates.

Several different types of animal waste research are being studied. A discussion on each of the following is included in this paper: (1) land loading with manure, (2) costs for livestock waste management facilities, (3) feedlot runoff control and application of runoff on crops, (4) feedlot runoff control and feedlot waste management, (5) feedlot soil and water chemistry and groundwater hydrology, (6) runoff effluent disposal on cropland, and (7) odors. There is an explanation of each of these different studies; together with plans for continuing the research. (Cameron-East Central).

### 1629-A7, B1, D1, F1

### CONTROL OF DUST FROM CATTLE FEEDLOTS

Texas Agricultural Extension Service, Texas A&M, College Station,
J. M. Sweeten.
Texas Agricultural Extension Service Report, Texas A&M University, College Station, April, 1974, 13 p. 2 fig, 1 tab, 12 ref.

Descriptors: *Control, *Dusts, *Cattle, *Feed lots, Rates of application, Sprinkling, Equipment, Air pollution, Sampling, Measurement, Stocking, Moisture, Costs.
Identifiers: Manure, Chemical application.
J. M. Sweeten.

Feedlot dust control methods including water application rates, equipment, treatment costs, and alternate strategies are described. The most important step in effective dust control is to attack the problem early and maintain steady control. The best means of feedlot dust control is water application. Either permanent sprinklers or mobile equipment can be designed, managed, and operated to provide effective feedlot dust control. Conclusions are that the cheapest and most effective means of dust control is application of water to the feedlot surface at a rate of 1 gallon per square yard per day (0.18 inches per day) initially, followed by daily water treatments of ½ gallon per square yard per day. Dust control practices should be initiated whenever the moisture content of loose surface manure falls below 20% (wet basis). (Cartmell-East Central).

### 1630-D3, E3

### MANURE AS A FUEL

Calf News, Vol. 12, No. 3, p. 48, 86-87, March, 1974. 2 fig.

Descriptors: *Fuels, *Farm wastes, *Waste treatment, *Waste disposal.
Identifiers: *Manure, *Composting, *Agricultural wastes.
If all agricultural wastes from plants and animals were available, they could be converted to energy equal to one-fifth of the petroleum or one-fourth of our natural gas requirements. A low-cost, high volume method of converting animal and plant wastes into a sulfur-free fuel through a new rapid composting process has been proposed as an immediate and practical way to face the current energy crisis, Feedlot manures alone would supply energy exceeding the total propane and other fuels would be freed to operate tractors and trucks or for other uses such as heating schools, homes and hospitals. Scientists have learned that organic wastes when composted produce a clean, sulfur-free fuel resembling lignite. This compost-fuel can also be produced at a lower cost than oil, propane, natural gas, coal, or other such fuels. The fuel is also stable and safe to handle or store. (Russell-East Central).

### 1631-A6, A10, A13, B2,B5, D3

### THEORETICAL CONSIDERATIONS OF ANAEROBIC LAGOONS FOR POULTRY WASTES

Agricultural Engineering Department, Iowa State University, Ames.
E. P. Taiganides.
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, 12 p. 1 fig.

Descriptors: *Lagoons, *Poultry, *Farm wastes, *Waste treatment, *Waste disposal, *Anaerobic conditions, Odor, Design.
Identifiers: Flies.

Lagoons for the treatment and disposal of farm animal wastes are not the panacea they are reputed to be by the farm press. They have not been found suitable for the treatment of animal manures because of their high land surface and water requirements. The design criteria for the reduction of the solid matter of manure have not been established. Generally, lagoons will be judged by the following criteria: stabilization of the influent, control of odors, control of flies, and appearance. A properly functioning anaerobic lagoon should produce no vile odors. The main factors in anaerobic digestion are: temperature, loading rate, solids concentration, detention periods, volatile acid concentration, solid matter accumulation and scum formation, essential nutrients concentration, toxic substances, and pH. Some of the design criteria for anaerobic lagoons discussed are: size, water depth, inlet, outlet, shape, and location, The most advantageous time to start a lagoon is during the summer. Seeding procedures are discussed. Mixing aids the manure degradation process. Flies will not breed in an anaerobic lagoon unless a scum forms. Good bacteria husbandry dictates the continuous feeding of the lagoon, except when it is frozen. The value of anaerobic lagoons will be better defined after the end of experiments now in progress. (Solid Waste Information Retrieval System).

### 1632-A11, C2, E3, F1,F2

### FEEDING STEERS DPM

Calf News, Vol. 11, No. 7, p. 26. July, 1973, 1 fig.

Descriptors: *Feeds, *Poultry, *Cattle, Proteins, Performance.
Identifiers: *Dehydrated poultry manure, Food and Drug Administration.

The poultry people have a product they are eager to bring into the cattle feeding market—dehydrated poultry manure. Properly processed poultry waste can be produced in large volumes for a cost to the producer of around $35 to $40 a ton. The holdup, up to now, has been the fact that the Food and Drug Administration has not given approval to use this product as a feed ingredient. On the other hand, there are several thousand cattle that are being fed poultry waste. As the law is now written, as long as one feeds the dried poultry waste in the State (other than transporting it across State lines), the Food and Drug Administration will cause you no problem. Because dehydrated poultry manure is inexpensive and has nutritional value, cattle owners may turn to this product as a cheaper source of supplement to their cattle rations, (Cartmell-East Central).

## 1633-A2, B2, B4, E2

### FAST FLUSH SYSTEMS

R. H. Brown.
Feedlot Management, Vol. 15, No. 11, p. 10-12, November, 1973. 4 fig.

Descriptors: *Farm wastes, *Cattle, *Waste treatment, *Waste disposal, *Feed lots, *Irrigation, Slopes, South Carolina.
Identifiers: Forage yields.

A southeastern U.S. Cattle farm uses fast flushing to remove wastes from concrete floors. Walworth Farms, feeding up to 5,000 head of cattle, flushes the 2½% sloping floor with up to 9,000 gallons of water. Runoff flows into a catch ditch to an underground pumping station which further liquifies it and then it flows into portable irrigation pipes. The runoff irrigates up to 1,600 acres of grassland and cropland. The farm also employs two lagoons to handle excess water when there are heavy rains. (Franz-East Central).

## 1634-A2, A4, B2, B3, B4, F1

### HE SOLVED HIS MANURE HANDLING PROBLEM

T. J. Brevik.
Hoard's Dairyman, p. 357, March 10, 1973. 1 fig.

Descriptors: *Farm wastes, *Dairy industry, *Waste treatment, *Waste storage, *Feed lots, *Runoff, Water pollution, Design, Wisconsin.
A Wisconsin farmer developed a waste handling system that prevented barnyard runoff from running down a slope into a nearby stream. The plan included a 50x50x11 ft. concrete storage pit and curbs which diverted runoff from its natural course. A manure thrower was positioned at the end of the barn to sling wastes into the pit. A 40x60x7 ft. detention pond was recently added. Costs for the project were shared by ASCS. (Frantz-East Central).

## 1635-A6, B2, D1, D3

### MINIMUM AERATION FOR CONTROL OF ODORS FROM SWINE WASTES

J. C. Converse, and D. L. Day.
Illinois Research, Vol. 14, No. 1, p. 12-13, 1972. 1 fig, 3 tab.

Descriptors: *Aeration, *Odor, *Hogs, *Farm wastes, *Waste treatment, Oxygen, Oxidation-reduction potential, Oxidation lagoons.
Identifiers: *Swine,

A study was conducted to determine whether odors could be kept at an acceptable minimum if a liquid swine manure system was operated so that no residual dissolved oxygen was present. A second objective was to determine how much the manure would be degraded under such conditions. The study was over a 22-week period. The system consisted of five chambers, each holding a constant volyıyne of 15 liters. Contents of the chamber were mixed continuously so a representative portion of the liquor was removed daily. Chamber 1 was excessively aerated, but chamber 5 did not receive any air at all. Air was added continuously to chambers 2, 3, and 4 at rates to maintain the oxidition reduction potential (ORP) at -200, -300, and -400 millivolts, respectively. Data and figures are given as to the results from each of the 5 chambers. As a result of this test, it was found the ORP should be maintained in the range of -300 to -340 and pH in the range of 7.7 to 8.5. (Cameron-East Central).

## 1636-B1, D3, E3, E4, F5

### MANURE IS FOOD FOR PROTEIN

E. W. Manthey.
Feedlot Management, Vol. 16, No. 3, p. 18-22, March, 1974. 5 fig.

Descriptors: *Farm wastes, *Cattle, *Feeds, *Proteins, *Recycling, *Waste treatment, Nutrients, Fermentation, Thermophilic bacteria.
Identifiers: *Manure, *Refeeding, *General Electric.

A breakthrough in development of a process to convert cattle manure into feed so that it can be recycled in the feedlot was announced by General Electric. GE has opened a plant designed to convert cattle manure into a pasteurized protein powder by an aerobic fermentation process. This process feeds the manure to a strain of thermophilic bacteria that thrives on it under conditions set up in the plant. GE then harvests and dries the bacteria into a high protein feed supplement that can be fed to cattle. All of the manure is consumed in the process and even the water is used. The end product is bland, grayish powder that analyzes 55% protein. The system harvests 1⅓ pounds of protein per one pound of waste fed into the system. The product is actually the bacteria themselves, and the manure is only a source of energy. It is hoped that after experimental feeding proves the process a success, GE will begin marketing and producing the product on a large scale. (Russell-East Central).

## 1637-A11, B1

### HIGH FAT RATIONS FOR RUMINANTS. II. EFFECTS OF FAT ADDED TO CORN PLANT MATERIAL PRIOR TO ENSILING ON DIGESTIBILITY AND VOLUNTARY INTAKE OF THE SILAGE

Ohio Agricultural Research and Development Center, Wooster.
R. R. Johnson, and K. E. McClure.
Journal of Animal Science, Vol, 36, No. 2, p. 397-406, February, 1973. 8 tab, 20 ref.

Descriptors: *Feeds, *Silage, *Ruminants, Energy, Limestone, Farm wastes.
Identifiers: *Rations, *Fats, *Digestibility, Voluntary intake.

Saturated and unsaturated animal and vegetable fat were included with corn silage at levels of 4%, 8% and 12%. Beef steers and sheep were fed the silages on a voluntary consumption basis. A limestone addition alleviated an intake depression effect of unsaturated fat for cattle and sheep. The fat provided a larger contribution, 33%, of energy requirements, than had previously been successful. The organic acids in each of the 12 silages were analyzed. Feces were analyzed to determine the digestibility of each silage. The fat content of each silage is shown. (Frantz-East Central).

## 1638-A2, A4, B2, F2

### EPA PREPARING TO "RAILROAD" THROUGH NEW POLLUTION RULES COVERING CATTLE FEEDLOTS

Beef, Vol. 9, No. 12, p. 4-5, August, 1973.

Descriptors: *Feed lots, *Cattle, *Farm wastes, *Effluent, *Water pollution, *Regulation, Livestock, Runoff.
Identifiers: *Environmental Protection Agency.

The U.S, Environmental Protection Agency, under a court order, is attempting to write regulating guidelines for effluent limitations on all industries. EPA has contracted Hamilton Standard to write the report. The proposed regulations do not allow any effluent discharge, regardless of weather conditions. Industry leaders are puzzled about the regulations and are hoping to have some influence on them when they go through the Federal Register. The regulations must be put into effect by October 18, 1973—the court-imposed deadline. (Frantz-East Central).

## 1639-A3,A5,B2,C1,C2,C3,E2

### EFFECTS OF SURFACE IRRIGATION WITH DAIRY MANURE SLURRIES ON THE QUALITY OF GROUNDWATER AND SURFACE RUNOFF

Department of Agricultural Engineering, Tennessee University, Knoxville.
J. C. Barker and J. Sewell.
Transactions of the ASAE, Vol. 16, No. 4, p. 804-807, July-August, 1973. 1 fig, 4 tab, 9 ref.

Descriptors: *Irrigation, *Dairy industry, *Farm wastes, *Slurries, *Water quality, Ground water, Surface runoff, Bacteria, Nitrates.
Identifiers: *Manure.

The major objectives of this study were to determine the effects of slurry irrigation on surface runoff and groundwater quality and to develop techniques for irrigating with dairy manure slurry, One acre of concrete lot, loafing area, and building roofs at a dairy with about 125 milking cows was served by a slurry irrigation system where manure slurry, rainfall runoff, and wastewater were collected into drains and delivered by gravity flow into a 75,000-gallon concrete storage tank. The slurry was delivered through 4-in. portable aluminum irrigation pipeline to the field sprinkler. Grab samples of surface and groundwater were collected and analyses were made for bacteria, biochemical oxygen demand, dissolved solids content, nitrate nitrogen, orthophosphate, chloride, and residues. All median surface runoff nitrate nitrogen concentrations were within the permissable criteria for raw water for public supplies. All surface runoff chloride concentrations were well within the permissable criteria. The dissolved solids content of the manure-saturated surface runoff generally exceeded acceptable standards. The coliform bacteria concentrations for the surface runoff from both the manure-saturated and the conventional pasture exceeded the standard. (Cartmell-East Central).

## 1640-A2,A8,B2,B4,E2,F1

### IRRIGATION FOR LAND APPLICATION OF ANIMAL WASTE

Departmentt of Agricultural Engineering, Purdue University.
B. C. Horsfield, R. Z. Wheaton, J. C. Nye, and J. V. Mannering.
Bulletin, Agricultural Engineering Department, Purdue University, West Lafayette, Indiana, 20 p. 7 fig, 7 tab.

Descriptors: *Farm wastes, *Irrigation, *Waste disposal, Livestock, Crops, Soils, Runoff, Costs, Equipment, Indiana.
Identifiers: *Land application, *Animal wastes.

Irrigation may be the best means of putting farm wastes back onto the land. Runoff detention, combination manure-and-runoff, and covered manure facilities are described. Major soil and cropping factors affecting irrigation rate are evaluated. Irrigation equipment and systems' costs are described. Tips are given on waste storage management, irrigation equipment use, soil conditions, and crop utilization practices. Only with proper management can the farmer attain the desired results of irrigation. (Frantz-East Central).

## 1641-B2, D3, E3, F5

### TEST SWINE WASTE DISPOSAL SYSTEMS

Iowa State University.
T. Hargrove.
Wallace's Farmer, Vol. 96, p. 30, July 24, 1971. 3 fig.

Descriptors: *Hogs, *Waste disposal, *Farm wastes, *Testing, Water pollution, Air pollution, Lagoons, Sprinkler irrigation, Water hyacinth, Nutrients, Effluent.
Identifiers: *Swine, Gutters, Flushing.

Iowa State has installed a gutter system in a hog house with a 100-gallon flush lasting 20 seconds once an hour. The swine cooperate. Flushings may be routed to an anaerobic lagoon, an oxidation ditch, or the lagoon and ditch in turn. The excess is spread on corn and/or grassland. Flushing water is recirculated. Water hyacinths are being tested for removal of nutrients from effluents followed by use as cattle roughage. Iowa winters will keep them from becoming a nuisance (Whetsone, Parker, Wells-Texas Tech University).

## 1642-B1, D1, D2, D3,E2

### EGG LAYING HOUSE WASTES

Vice President, Henry B. Steeg and Associates, Inc., Indianapolis, Indiana.
C. F. Niles, Jr.
Proceedings, Industrial Waste Conference, 22nd, Purdue University, May 2-4, 1967, Vol. 52, No. 3, p. 334-341. 1 fig. 2 tab.

Descriptors: *Farm wastes, *Waste storage, *Waste disposal, *Poultry, *Waste treatment, Drying, Anaerobic digestion, Incineration, Sedimentation, Centrifugation, Hydroponics, Sampling, Lagoons, Odor.
Identifiers: *Egg laying house, Land disposal.

Experiments were undertaken to find the best and most economical method of disposing wastes from the Berry Best Egg Company of Rockport, Indiana. The company houses approximately 205,000 laying hens. Manure, dead birds, and contaminated water were found to be the major types of wastes produced. Processes considered for use at the Berry Best Egg Company facilities included drying of the solids, controlled anaerobic digestion, land disposal, incineration, aerobic treatment, sedimentation, centrifuging, and hydroponoc agriculture. Each process was investigated and experimented with to determine which would be the best method. During experimentation, wastes were pumped from holding tanks into two trucks and hauled to farmland for disposal. After extensive investigation, it was found that disposal of manure by drying and the disposal of the hen carcasses by mixing with manure was a satisfactory method of disposal. The waste water is then eliminated by irrigation. It is hoped that the material produced by drying will find a commercial market, but it is too early to determine whether or not it will. (Russell-East Central).

## 1643-A6, A11, A12, B1, C3

### MICROBIOLOGICAL ASPECTS OF POULTRY WASTES

Department of Veterinary Microbiology, Texas A&M University, College Station.
B. H. Lewis.
Proceedings: Second National Poultry Litter and Waste Management Seminar, College Station, Texas, Sept. 30 and Oct. 1, 1968, p. 77-81. 2 ref.

Descriptors: *Farm wastes, *Poultry, *Microbiology, Nutrients, Odor, Pahtogenic bacteria, Litter, Management, Texas.

Microbial mechanisms can assist in the efficient management and utilization of poultry waste. There is need for fundamental information on the general nature of the complex microbial species comprising poultry waste products and the substrate conversions which those bacteria bring about. The primary population of poultry waste consists of the fecal flora as it exists in the animal intestine. Recent studies on the intestinal flora of the domestic fowl reveal that organisms classified under the lactobacillius, lactic streptococcus, and bacteroid groups are the predominate types of organisms in feces. The nature of the secondary population of poultry waste is poorly understood since research is lacking. Specific activities upon environmental substrates which would make the utilization of poultry waste products feasible are divided into two categories: (1) those activities which would serve to synthesize nutrients for animal or plant use and (2) those activities which would reduce or eliminate undesirable factors as odors, pathogenic residues, etc. Those microbial activities of intestinal bacteria which contribute to the welfare of the host potentially could serve in the utilization of waste products, as evidence indicates that intestinal bacteria are capable of synthesizing several vitamins, and those vitamins are found in the feces. Further research into the microbiology of poultry waste must include techniques for the quantitative and qualitative evaluation of complex populations. (Solid Wastes Information Retrieval System).

## 1644-B2, B3, D1, D3, E1

### TREATMENT OF ANIMAL WASTES AT THE GREENFIELD LABORATORIES OF ELI LILLY AND COMPANY

Eli Lilly and Company, Greenfield, Indiana.
T. W. Bloodgood.
21st Industrial Waste Conference Proceedings, Purdue University, Vol. 50, No. 2, p. 56-61, March, 1966, 1 tab, 1 ref.

Descriptors: *Waste treatment, *Farm wastes, Livestock, Waste disposal, Lagoons, Aeration, Effluent, Sewage.
Identifiers: *Animal wastes, *Greenfield Laboratories, *Eli Lilly and Company.

This paper describes the waste treatment facilities at the Greenfield Laboratories that handle the wastes generated by the thousands of animals used in the various production and research programs. There are five separate waste treatment plants that are located throughout the laboratories to serve the various research areas. Detailed description of wastes, treatment and disposal methods, and construction costs are given for each plant. The five plants are operated by two men from the Maintenance Department assigned to the Waste Treatment Operations. Total operating costs for all plants, not including utility costs, are approximately $55,000 a year. (Cartmell-East Central).

## 1645-A11, C2, D1, D2, E3

### ANIMAL WASTE MANAGEMENT AND NUTRIENT RECYCLING

Texas A&M University, College Station, Texas.
J. H. Quisenberry.
Latin American Poultry Congress, Mexico City, Mexico, March, 1972, 1972, 9 p. 7 tab, 1 ref.

Descriptors: *Farm wastes, *Management, *Nutrients, *Recycling, Poultry, Cattle, Fertilizers, Dehydration, Drying, Litter, Nitrogen, Phosphhorous, Potaassium, Moisture, Analysis, Performance, Feeds.
Identifiers: Animal wastes, *Refeeding, Dropuings, Pasteurization.

Not only was poultry litter found to be of considerable economic value when recycled, but the return appears to be more than sufficient to bear the expense of drying when artificial drying is necessary. By this process the waste management problem may be reduced or solved, and if it is found desirable, the return may be sufficient to pay for pasteurization treatment and still leave some margin of net profit. Animal wastes to be recycled must be free of toxic or harmful residues. Ruminants were found to utilize poultry waste better than poultry because of the high concentration of nitrogenous compounds in poultry manure. Cattle feeding trials found that poultry manure contained adequate protein, low fiber content, adtequate calcium and phosphorous, but insufficient vitamin A and D. (Russell-East Central).

## 1646-A1, A6, B2, B3, B4, D2, D3, E2, F1

### SYSTEMS AND SITUATIONS FOR HANDLING POULTRY WASTES

Department of Poultry Science, Cornell Universcity, Ithaca, New York.
C. E. Ostrander.
Presented at the Southeastern Poultry and Egg Association 1971 Poultry Health Seminar, Oct. 18-19, 1971, 7 p.

Descriptors: *Poultry, *Farm wastes, *Waste storage, *Waste treatment, *Waste disposal, *Recycling, Oxidation lagoons, Lagoons, Dehydration, Hydraulic equipment, Fertilizers.
Identifiers: *Waste management, *Land spreading, Pollution, Refeeding.

The problems of waste management have become increasingly important to poultry men primarily because of increase in flock size, concentration of birds, and the population migration to the country. Problems of odor, noise, and proper waste disposal must be faced, and no one system is the answer. Many different systems are now being used each with its own advantages and disadvantages. Some poultrymen have deep pits to hold the waste until it can be spread on land. These pits must be kept reasonably dry and must be cleaned at least once a year. Another system is the hydraulic system in which the droppings are pushed out by water pressure into a storage facility. Waste then must be placed in an aerobic lagoon to prevent odors. Some men use oxidation ditches. Some attempt storage for long periods of time. As a general rule, waste must eventually be spread on land. Recently, dehydration and recycling as feed has gained attention. Price has been the discouraging factor in dehydration, and only about 10% of the waste can be recycled as feed, leaving the rest to be disposed of by some other method. Perhaps through more research the best method will some day be found. (Russell-East Central).

## 1647-A9, A10

### HOUSE FLY CONTROL IN CAGED LAYER HOUSES

J. Aikman, and J. L. Lancaster, Jr.
Arkansas Farm Research, Vol. 21, No. 4, p. 4, July-August, 1972. 3 fig.

Descriptors: Larvae.
Identifiers: *Fly control, *Caged layers houses, *Manure, *Adulticides.

House fly control tests were conducted in three environmentally controlled houses for caged layers. The tests determined the effectiveness of manure removal coupled with applications of selective adulticides for house fly control. In the first house, manure was removed four times with water added. In the second house, manure was removed five times. But in the last house, a regular manure removal schedule was not maintaned. In each of the three houses bait was used to control adult flies. House fly counts were consistently higher in house #3. On the basis of this test, manure removal should begin early in the season and continue on a regular schedule for the entire fly season. This, along with applications of selective adulticides, will have good house fly control. (Cameron-East Central).

## 1648-A2, A6, A11, B2

### ODOR INTENSITIES AT CATTLE FEEDLOTS

Texas Agricultural Extension Service, Texas A&M University, College Station.
J. M. Sweeten, D. L. Reddell, L. M. Schake, and B. Garner.
Presented at the 1st Annual Symposium on Air Pollution Control in the Southwest, Texas A&M University, College Station, Texas, November 5-7, 1973, 17 p. 3 fig. 7 tab, 20 ref.

Descriptors: *Odor, *Feed lots, *Cattle, Air pollution, Runoff, Farm wastes, Measurement, Weather data, Moisture, Settling basins.
Identifiers: *Scentometer, *Calcium Bentonite, Odor intensity index.

Odor intensities measured at two cattle feedlots in Texas, ranged from 2 to 170 dilutions to threshold (DT) which nearly covered the measurement range of the scentometer. The average odor reading for the surface of a 4000 head feedlot, determined by monitoring four randomly selected pens for 7 months, was 30.7 DT. The runoff settling basin and retention pond averages 68 and 47 DT, respectively. Half of the odor intensities were more than 23 DT (which exceeds the odor standards in several states). At a 12,000 head feedlot, trials using calcium bentonite as a ration supplement (at 0.0, 0.8, and 2.0% levels) showed a reduction in odors from the 2% bentonite treatment. Bentonite also improved average daily gain of cattle during the first 21 days. The scentometer was found to be a useful, if somewhat imprecise, diagnosis tool for identifying the primary sources of odors within a cattle feedlot. (Russell-EastC entral.)

## 1649-A6, C1, C2, B3, D3, F1

### COMBINING MUNICIPAL WASTE WITH FEEDLOT WASTE

Texas Agricultural Extension Service, The Texas A&M University, College Station.
J. M. Sweeten.
Presented at the Fourth Annual Composting and Waste Recycling Conference, May 2-3, 1974, El Paso, Texas, 14 p. 3 tab, 18 ref.

Descriptors: *Municipal wastes, *Feed lots, *Farm wastes, *Waste treatment, *Waste disposal, Fertilizers, Odor, Nutrients, Moisture content, Costs, Economics, Sludge.
Identifiers: *Sanitaary landfill, *Land disposal, *Composting, Manure.

The characteristics and composting of both feedlot and municipal wastes are discussed in detail. Benefits of combining municipal solid wastes with feedlot waste appear to be on the side of muncipalities rather than the feedlot operator. At present day waste management costs, feedlot manure at $1.00-3.75 per ton is a bargain to farmers in terms of price and nutrient values as compared to municipal solid waste, which costs at least $7.75/ton composted and $2.00-3.80 per ton shredded only. In concentrated cattle feeding areas, sites suitable for sanitary landfills are usually plentiful, and municipalities will probably find sanitary landfilling a cheaper alternative than combining the refuse with animal waste for application on croplond. Raw or digested sewage is a more logical waste material to combine with municipal refuse since it is readily available, has similar properties to feedlot waste and presents a disposal problem of its own in nearly all cities. The concept of combining municipal refuse (composted or uncomposted) with feedlot manure does not appear feasible at this time, since municipal solid waste serves to dilute the nutrient value of manure. (Cartmell-East Central).

## 1650-A6, A7, C2

### CHEMICAL OXYGEN DEMAND AS A NUMERICAL MEASURE OF ODOR LEVEL

J. D. Frus.
MS Thesis, Department of Agricultural Engineering, Iowa State University, 1969, 101 p. 21 fig, 21 tab, 40 ref.

Descriptors: *Chemical oxygen demand, *Odor, *Measurement, *Farm wastes, Gases, Sampling, Hogs, Confinement pens, Temperature, Humidity, Ventilation, Iowa.
Identifiers: *Swine.

The specific objectives of this project were to determine if the chemical oxygen demand technique could be used as a quantitative measure of the organic gases present in a confinement swine building atmosphere and to determine if the level of organic gases could be correlated with: observed odor level, period of time animals are in the building, air temperature, relative humidity, rate of dilution by ventilation, and characteristics of the waste. Samples were tested once a week but, in this project, drawing definite conclusions appeared to be almost impossible. A satisfactory technique was developed to measure the COD of the atmosphere in a confinement swine building. Determinations of what the air COD value included were not conclusive, but some suggested trends are: (1) The air COD values can be correlated with noticeable differences in odor level as detected by the human nose; (2) The air COD technique detected more different gases when the pH of the manure was above 7.0 than when it was below 7.0; (3) The air COD value rises sharply when the ventilation is turned off and drops sharply when it is turned on again; (4) The air COD values are the lowest when the pH of the manure in the pit is in the range of 6.8 to 7.2. (Cartmell-East Central).

## 1651-A6, B2, B5, D3

### MANURE TRANSPORT IN A PIGGERY USING THE AEROBICALLY STABILIZED DILUTE MANURE

R. J. Smith.
MS Thesis, Department of Agricultural Engineering, Iowa State University, Ames, Iowa, 1076, 99 p. 18 fig, 10 tab, 64 ref.

Descriptors: *Aerobic treatment, *Anaerobic conditions, *Lagoons, *Farm wastes, *Hogs, Oxidation lagoons, Biochemical oxygen demand, Waste treatment, Cellulose, Equipment, Effluent, Sludge, Odor, Foaming, E. Coli, Analysis, Animal behavior.
Identifiers: *Manure transport, *Piggery, Housing.

Lack of satisfaction with the quality of effluent provided by an anaerobic lagoon as the sole biological treatment process for a confinement swine finishing house caused an investigation to be made of a combined anaerobic/aerobic treatment system. The performance of the total scheme has proven satisfactory. When using the system, no fresh water is required for manure transport. Continuous manure removal serves to keep odors at a low level in the building, and the systems treat and transport manure automatically. This reduces labor requirements for management of the operation. The effect of an anaerobic lagoon has proven to be beneficial in that its a good means of degrading cellulose. Also with a lagoon being used to remove a large fraction of the BOD from the waste before it enters the oxidation ditch, no serious foaming problems were encountered. (Russell-East Central).

## 1652-A2,B2,C1,C2,D3,F1

### DESIGN AND OPERATION OF A FEEDLOT RUNOFF TREATMENT SYSTEM

D. S. Backer.
MS Thesis, University of Nebraska, Department of Civil Engineering, 1973, 46 p. 10 fig, 9 tab, 34 ref.

Descriptors: *Waste treatment, *Runoff, *Feed lots, *Design, Operation and maintenance, Equipment, Costs, Automation, Odor, Aeration, Chemical oxygen demand, Suspended solids, Effluent, Hydrogen ion concentration, Analysis.

This study dealt with the design, start up, and operation of a pilot plant built to treat feedlot runoff. The plant's purpose was to provide a system which was substantially automatic and economical in operation. The plant was evaluated for simplicity of construction, ease of operation and maintenance, cost of operation, effectiveness of treatment, and comparability to the laboratory unit. The design of the pilot plant was based on an aerobic unit that featured an air lift pump to return solids to the aeration chamber. Laboratory analyses were run on pH, chemical oxygen demand, and suspended solids. COD and suspended solids removals increased with increased detention time. The unit operated in the pH range 6.5-8.5. The net cost per animal was approximately $.60 for the experimental system. The field unit was easy to construct, required very little maintenance and was simple to operate. (Cartmell-East Central).

## 1653-A8, B2, C2, E2

### THE RESPONSE OF PASTURES IN NORTHERN ISLAND TO N, P, AND K FERTILIZERS AND TO ANIMAL SLURRIES. I. EFFECTS ON DRY-MATTER YIELD

Agricultural and Food Chemistry Department, Queen's University at Belfast, Northern Ireland.
S. N. Adams.
Journal of Agricultural Science, Vol. 81, pt. 3, p. 411-417, December, 1973. 1 fig. 6 tab, 14 ref.

Descriptors: *Fertilizers, *Slurries, *Farm wastes, Potassium, Nitrogen, Ammonium, Phosphorous, Nutrients, Soils, Waste disposal, Rates of application.
Identifiers: *Pasture response, *Northern Ireland, *Land spreading.

In Northern Ireland, experiments were conducted from 1969 to 1972 to measure effects on yield of 0, 180, or 360 kg of nitrogen 0, 30, or 60 kg of phosphorous; and 0, 150, or 300 kg of potassium/ha/year, both with and without 138,000 liters of slurry/ha. Results indicated that there was almost always a large increase in pasture yield when nitrogen was added. There were slight increases in yield when potassium was added and almost no effect either positively or negatively by phosphorous. In tests when slurry was added, the response of the yield to nitrogen was reduced and almost eliminated in phosphorus and potassium applications. The effect on yield was an increase because the ammonium-nitrogen in the slurry contributed the necessary nitrogen. Also when slurry was applied the nitrogen, potassium, and phosphorous concentrations were high and variable. This forces the conclusion that slurry application is a very inaccurate method of fertilizing. In fertilizing, the deficiencies of the farm as a whole should be evaluated to determine the proper amount of nutrients to add to the soil. (Russell-East Central).

## 1654-A8, B2, C2, E2

### THE RESPONSE OF PASTURES IN NORTHERN IRELAND TO N, P, AND FERTILIZERS AND TO ANIMAL SLURRIES. II. EFFECTS ON MINERAL COMPOSITION

Agricultural and Food Chemistry Department, Queen's University of Belfast, Northern Ireland.
S. N. Adams.
Journal of Agricultural Science, Vol. 81, pt. 3, p. 419-428, December, 1973. 3 fig, 6 tab, 11 ref.
Descriptors: *Fertilizers, *Slurries, *Farm wastes, Potassium, Phosphorous, Nitrogen, Nutrients, Calcium, Magnesium, Sodium, Rates of application.
Identifiers: *Pasture response, *Northern Ireland, Minerals, Herbage.

In Northern Ireland, pasture samples were taken and analyzed to determine the percent of nitrogen, phosphorus, potassium, calcium, magnesium, and sodium present. These analyses were conducted to find out the effect of nitrogen, phosphorus, and potassium fertilizers and slurry which had been added to the pasture. The data was then evaluated to see if a fertilizer policy designed for maximum yield should be modified after taking mineral content into account. It appears that the nitrogen amount to be added should be considered independently and with disregard to mineral content to achieve maximum yield. The amounts of phosphorus and potassium fertilizers added should be determined to avoid excess or depletion. Potassium and phosphorus fertilizer is much more effective than slurry amounts. In calculation of the proper amount of slurry to be added, one should also calculate the proper amount of potassium and phosphorous fertilizer which should be added to the slurry. On first cut, the slurries provided on an average: 115 kg $NH_4$-N/ha; 114 kg K/ha; 86 kg P/ha. (Russell-East Central).

## 1655-A8, B2, C2, E2

### THE RESPONSE OF PASTURES IN NORTHERN ISLAND TO N, P AND K FERTILIZERS AND TO ANIMAL SLURRIES. III. EFFECTS IN EXPERIMENTS CONTINUED FOR EITHER TWO OR THREE YEARS

Agricultural and Food Chemistry Department, Queen's University at Belfast, Northern Ireland.
S. N. Adams.
Journal of Agricultural Science, Vol. 82, pt. 3, p. 125-137, February, 1974. 3 fig, 4 tab, 17 ref.

Descriptors: *Fertilizers, *Slurries, *Farm wastes, Nitrogen, Phosphorus, Potassium, Ammonium, Rates of application.
Identifiers: *Pasture response, *Northern Ireland, Herbage.

Experiments were conducted in Northern Ireland on pastures to determine the effect on yield and mineral content of 0, 180, and 360 kg Nitrogen, 0, 30, or 60 kg phosphorus, and 0, 150, or 300 kg potassium/ha/year both with and without 138,000 liters slurry/ha. These were conducted in 1970 and 1971 on the same sites and with the same applications as previous experiments in 1969. The nitrogen content in the soil in the second and third seasons was similar to the first season with good yields and no nitrogen buildup. Evidence showed that the soil reserves of phosphorus were not being depleted, and the slurry phosphorus seemed to be adequate to maintain the proper level. The potassium in the soil on the other hand was getting smaller with accompanied reductions in yield. Adding fertilizer potassium prevented this reduction, but the potassium in the slurries was less effective. This is probably because the potassium in the slurries is organically bound. (Russell-East Central).

## 1656-A2, A4, F6

### MATHEMATICAL MODELING AND SYSTEM ANALYSIS OF CATTLE FEEDLOT RUNOFF MANURE WASTES

S. Kang.
MS Thesis, Department of Chemical Engineering, Kansas State University, 1969, 150 p. 36 fig, 14 tab, 29 ref.

Descriptors: *Mathematical models, *Systems analysis, *Feed lots, *Runoff, Cattle, Water pollution, Dimensional analysis, Simulation analysis, Rainfall.
Identifiers: Analog computer, Quasilinearization.

The control of water pollution by feedlot runoff can not be accomplished effectively without an appropriate understanding of the system. In this study, the emphasis was on obtaining a mathematical relation which relates the important dependent variables of the system to the important independent input variables. A simplified nonlinear model of the systems is first proposed.. An analog computer is used to solve the nonlinear equations. Correlation of the system parameter to the rainfall intensity is discussed. Analog computer simulation was found to be satisfactory in the study of transient behavior of the system. Based on the proposed model, the injection rate of the organic matter into the runoff solution is found to be very approximately linear with respect to the rainfall intensity. This injection rate is somewhat independent of the surface condition of the feedlot system. For a complex physical system, the response of the system under varied input variables may be the most informative knowledge to justify a proposed modeling. It is suggested that additional hydraulic and concentration data be taken systematically and in a shorter time interval. (Cartmell-East Central),

## 1657-B2,B3,D1,D2,D3,E3

### MINERALIZATION OF NITROGEN IN MANURES MADE FROM SPENT-SLURRY

Division of Soil Science and Agricultural Chemistry, I.A.R.I., New Delhi, India.
R. D. Laura, and M. A. Idnani.
Soil Biological Biochemistry, Vol. 4, p. 239-243, 1972. 3 tab, 18 ref.

Descriptors: *Nitrogen, *Fertilizers, *Slurries, Urea, Dehydration, Absorption.
Identifiers: *Mineralization, *Manure, *Spent-slurry, Composting.

The problem of using liquid spent-slurry or sludge was studied from three aspects: (1) the dehydration of slurry by absorption in materials like green leaf powder; (2) the use of slurry to initiate composting of other waste materials; and (3) the production of concentrated organo-mineral fertilizer by adding urea to the dried slurry. Manure prepared by absorption in green leaf powder proved to mineralize rapidly, which would indicate that this is a valuable means of utilizing slurry. Sun drying reduced mineralization considerably more than absorption. Liquid slurry was also found to be superior to farm compost. Mineralization was increased with alternate wetting and drying and with 1% sodium hydroxide added to the dry slurry. The organo-mineral fertilizer prepared by adding urea yielded over 50% nitrogen which was 30% less than from urea alone. (Russell-East Central).

## 1658-A3, A5, A6, A7, B1, C2, F1, F6

### CONTROLLING SEDIMENT AND NUTRIENT LOSSES FROM AGRICULTURAL LANDS

Department of Agricultural Economics, Cornell University, Ithaca, New York.
J. J. Jacobs.
Cornell Agricultural Economics Staff, Paper No. 72-20, June, 1972, 16 p. 2 fig, 4 tab, 20 ref.

Descriptors: *Sediment control, *Nutrients, *Agriculture, *Phosphorus, Farm wastes, Livestock,

Water pollution, Runoff, Model studies, Costs. Sources of potential pollutants from agricultural production are: sediment from erosion; plant nutrients; livestock manure; pesticides; waste from processing plants; air pollution, primarily odors and dusts. Sediment and phosphorus were cause of the magnitude of sediment as a pollutant, the increased emphasis on phosphorus as a likely key nutrient in limiting growth of aquatic plant life, and the diffuse source of such pollutants from agricultural runoff as compared to point sources. Surface runoff from agricultural cropland is the primary transport agent of sediment entering surface waters. Therefore, planning for the control of sediment requires knowledge of the relations between those factors that cause loss of soil and those that help reduce such losses on croplond. The methods allowed for controlling sediment and phosphorus losses are presented. The question of which control methods and at what level depends on the level of water quality desired, the unit cost coefficients of alternative methods, and the technical coefficients of the alternative methods. A summary of the cost coefficients are presented, Sediment and phosphorus coefficients were also estimated for each management system listed. (Cartmell-East Central).

## 1659-A8, B1, E2

### ULTIMATE DISPOSAL OF WASTES TO SOIL

Battelle Memorial Institute, Pacific Northwest Laboratory, Richland, Washington.
R. C. Rouston, and R. E. Wildung.
Chemical Engineering Progress Symposium Series, Vol. 65, No. 97, p. 19-25, 1969. 49 ref.

Descriptors: *Wastes, *Farm wastes, Ultimate disposal, Recycling, Waste storage, Dispersion, Nitrogen, Phosphorus, Sulfur, Ammonia, Ion exchange, Filtration.
Identifiers: Soil, Dilution, Soil interconversions, Buffers, Organic materials, Transformations.

Soil is a complex medium which is capable of reacting with a broad spectrum of extraneous materials. The nature of these reactions is such that soil may function as a medium for either waste storage or for ultimate waste disposal. Soil is composed of inorganic minerals, organic materials, and a living population of organisms. A soil system is a highly reactive system which may bind or alter the composition of waste solutions added to it. Soil properties important to the efficient use of the soil as a disposal medium include ion exchange capacities, buffer capacity, filter characteristics, and microbial transformations, The ultimate disposal alternatives available with respect to soil systems are the reuse and transformation of waste. In the reuse category are those solute disposants which are major essential elements to plants. In the transformation category are the inorganic or biological components which can be transformed to be useful for plant growth. The elements nitrogen, phosphorus, and sulfur would be most amenable to biological interconversions. (Russell-East Central).

## 1660-A5, C2, E2

### FLUCTUATIONS IN NITRATE CONCENTRATIONS UTILIZED AS AN ASSESSMENT OF AGRICULTURAL CONTAMINATION TO AN AQUIFER OF A SEMIARID CLIMACTIC REGION

Eastern New Mexico University, Portales.
R. G. Taylor, and P. D. Bigbee.
Water Research, Vol. 7, No. 8, p. 1155-1161, August, 1973. 1 fig, 4 tab, 9 ref.

Descriptors: *Nitrates, *Fluctuations, *Water pollution, *Aquifers, Semiarid climates, *New Mexico, Investigations, Agriculture, Sampling.
Identifiers: Health, Concentration, Agricultural practices.

This study was conducted to observe fluctuations in nitrate concentrations in an agricultural area near the eastern border of New Mexico. Nitrate concentrations have been utilized in this study to demonstrate their applicability to examining agriculture practices which contaminate aquifier water. Areas treated with nitrogenous fertilizers and subsequently irrigated were found to contain aquifier fluctuations in nitrate content directly in proportion to irrigation seasons. Agricultural industries with high animal densities per land area, and high water consumption for maintenance, were found to have high, but non-fluctuating, nitrate concentrations, Areas with high animal density per land area with low water usage for maintenance; areas with low animal density per land area; and agricultural practices for which little or no nitrogenous fertilizers were used demonstrated low aquifier nitrate concentrations regardless of water usage. It was concluded that fluctuations in nitrate concentrations in an aquifier can be utilized in assessing the contamination resulting from agricultural practices in semiarid climates. (Solid Waste Information Retrieval System).

## 1661-A6, B2, D3, F1

### OXIDATION WHEEL ELIMINATES ODORS, MANURE HANDLING AND POLLUTION

Compost Science, Vol. 13, No. 1, p. 28, January-February, 1972.

Descriptors: *Oxidation, Farm wastes, *Odor, *Hogs, *Aeration, Poultry, Slurries, Costs, Waste treatment.
Identifiers: *Oxidation wheel, *Manure.

Paul Smart is using an oxidation wheel that is economically feasible and virtually maintenance free. The key to Smart's success is his new wheel design. He is using 26 of the massive units—which measure 36" wide by 60" in diameter. The big diameter on the new wheel lets the bearings sit up on the walls of the pit away from the slurry. The wheels whip oxygen into the manure slurry as it flows around in a race-track-shaped pit. The aeration encourages growth of aerobic bacteria, which break down manure without forming the usual foul-smelling gases. University of Kansas tests show the new design puts 4 lbs. of oxygen per hour per wheel into the pit. The result is a thick reddish sludge that oozes from each house to an evaporation pond. Costs for operation of the wheels is 89c per hog marketed. One wheel costs about $37 a month to run. Smart is confident the wheel will work well for poultry, but admits to reservations for cattle. (Cameron-East Central).

## 1662-B1, D2, D3, E2

## THESE STOCKYARDS' SOLUTIONS COULD WORK FOR YOU

Feedlot Management, Vol. 15, No. 5, p. 48-52, May, 1973. 3 fig.

Descriptors: *Livestock, *Farm wastes, *Feed lots, *Management, Waste treatment, Waste disposal, Lagoons, Incineration.
Identifiers: *Stockyards.

A tour of several markets turned up a number of methods for successfully handling livestock wastes. These techniques might be adaptable to feedlot operations. Features that will make waste removal faster and more efficient include a flow-through alley system, new concrete floors to replace brick floors, and steel pens instead of the present wooden ones. Most large markets are successfully meeting the challenge of controlling pollution. Major remodeling programs, and such new concepts as lagoon systems, disposal districts, and incinerators require large financial expenditures. (Cartmell-East Central).

## 1663-A4, A5, C2, E2

## INFLUENCE OF AGRICULTURAL PRACTICES ON WATER QUALITY IN NEBRASKA: A SURVEY OF STREAMS, GROUNDWATER, AND PRECIPITATION

Department of Agronomy, Nebraska University, Lincoln.
R. A. Olson, E. C. Seim, and J. Muir.
Water Resources Bulletin, Vol. 9, No. 2, p. 301-311, April, 1973, 3 fig, 2 tab, 11 ref.

Descriptors: *Water quality, *Nebraska, *Surveys, *Water pollution, Nitrogen, Phosphorus, Fertilizers, Farm wastes, Industrial wastes, Sewage.
Identifiers: Agricultural practices.

The objective of this investigation was to determine if agricultural practices in Nebraska are contributing to pollution of the state's water resources. A water-sampling program was initiated throughout Nebraska in 1970 for the purpose of establishing the sources of nutrients enriching Nebraska's waters. Particular emphasis was placed on measuring the forms and amounts of nitrogen and phosphorus—two of the primary nutrients contained in fertilizers. Significant quantities of N and P were found in the precipitation of Nebraska, ranging from 5-7 pounds N/A in the west to 10-14 pounds in the east and ½-1 pounds *P*/A in the same directions. Elevated nutrient levels of Nebraska's streams were more often than not traceable to industrial, livestock, and sewage waste intrusions. Phosphorus content has remained essentially constant, but there is evidence of a small increase in the average $NO_3$-N content, of Nebraska groundwater during the past 10 years, a period during which fertilizer N use has quadrupled. Some individual cases of misuse of fertilizers are recognized, but the weight of evidence from this investigation indicates that fertilizers aren't contributing significantly to the degradation of surface and groundwater quality in Nebraska to date. (Cartmell-East Central).

## 1664-A2, C2, F6

## A PROGRAMMED SAMPLER FOR RUNOFF AND BEDLOADS

Agricultural Research Service, Lincoln, Nebraska.
N. P. Swanson.
Transactions of the ASAE, Vol. 16, No. 4, p. 790-792, July-August, 1973. 5 fig, 5 ref.

Descriptors: *Feed lots, *Runoff, *Bed load, *Nebraska, *Sampling, *Pollutant identification, Chemical analysis, Rain gauge, Hydrograph analysis, Farm wastes.
Identifiers: Feedlot research, Quantitative analysis.

A programmed, automatic sampler that collects a sequence of composite samples of runoff and accompanying bedloads has been in use on a feedlot research installation near Lincoln, Nebraska, for over four years. The sampler consists of an arm and dipper electrically driven by a gear reduction motor through sprockets and a chain, a tipping bucket that collects the samplings from several rotations of the dipper and delivers them as a single sample, a turntable holding successive sample containers, a gear reduction motor moving the turntable by a friction drive, and a program timer. Composited samples are collected over five minute sampling periods with volumes of about three liters. The sampler can be programmed to obtain individual samples for any of the 144 five minute periods during 12 total hours of actual operation. The runoff need not be continuous. The time of collection of each sample is recorded to relate to the runoff hydrograph and recording rain gauge chart. Bedload particles up to 5/8 inch in diameter can enter the rotating sampler dipper which passes under the discharge. The sampler permits both qualitative and quantitative analyses of runoff with relation to time for an event. Maintenance and field servicing requirements have been minimal (Merritt-FIRL).

## 1665-A2, A4, A12, B2, C1, C2, C3, F6

## MICROBIAL ECOLOGY AND INFECTIOUS DRUG RESISTANCE IN A FARM WASTE LAGOON

Young Nam Lee.
MS Thesis, Department of Bacteriology, North Dakota State University, June, 1971, 56 p. 10 fig, 7 tab, 72 ref.

Descriptors: *Farm wastes, *Lagoons, *Ecology, *Bacteria, *Microbiology, Feeds, Antibiotics, Sampling, Biochemical oxygen demand, Hydrogen ion concentration, Algae.
Identifiers: *Drug resistance.

Two phases of research constituted this study. The first phase was to study the monthly physical, biochemical, and microbiological variation in a barn waste lagoon located near North Dakota State University, Fargo. This lagoon drains into the Red River and any antibiotic resistant organism present could come in contact with sensitive human pathogens in a public water supply. The second phase concerned assays of the antibiotic sensitivity spectra of lagoon isolates originating from the intestinal tract of animals on feed supplemented with antimicrobial agents. Data indicated that this lagoon may constitute a potential health hazard due to a low, but consistent, population of antibiotic-resistant enteric pathogens which may gain access to public waters. More than three hundred and fifty gram negative bacteria were isolated and screened for determination of the resistance to antimicrobial agents commonly used as growth promoting feed additives. Conjugation experiments were also conducted to demonstrate the transferability of R factors carrying multiple antibiotic resistance. The release of organisms carrying R factors from farm animals on conventional feeds may play a role in the spread of multiple drug-resistant strains. (Russell-East Central).

## 1666-B2, D3

## PERFORMANCE OF A CAGE ROTOR IN AN OXIDATION DITCH

R. S. Knight.
MS Thesis, Department of Agricultural Engineering, Iowa State University, 1965, 83 p. 25 fig, 5 tab, 30 ref.

Descriptors: *Oxidation lagoons, *Performance, *Farm wastes, Aeration, Equipment, Velocity, Waste water treatment, Activated sludge, Flocculation, Waste treatment.
Identifiers: *Oxidation ditch, *Cage rotor.

The cage rotor aerator tested in this study is a very efficient method of mechanical aeration and should have definite applications in waste water treatment. The rotor was capable of transferring up to 5.65 lbs. of oxygen per foot of rotor at 12 inches immersion at 100 rpm and should be capable of greater transfers at higher speeds. The most efficient immersion depth of the rotor was 3 inches, and it was capable of efficiencies of 5.28 to 6.76 pounds of oxygen per kilowatt hour at this immersion. There also appears to be a relationship between the velocity of the water in the ditch and the oxygen transferred at any constant output of the rotor. If the power output is held constant, the oxygen transferred tends to increase as the velocity decreases. However, all velocities at all rotor speeds and immersions appear to be sufficient to keep an activated sludge floc in suspension. One other finding was that the oxygen transfer possibilities are effected by the volume or shape of the aeration tank. In other words, the results of rotor performance studies in one type of aeration tank should not be accepted as accurate transfer values for the same rotor in a tank of different size and shape. (Russell-East Central).

## 1667-B2, C3, D3

## THERMOPHILIC BACTERIAL OXIDATION OF HIGHLY CONCENTRATED SUBSTRATES

Stuttgart University, Institute of Siedlungswasserbau, 7 Stuttgart 1, Maliwek 9, Federal Republic of Germany.
F. Popel and CH. Ohnmacht.
Water Research, Vol. 6, p. 807-815, 1972. 6 fig, 3 tab, 9 ref.

Descriptors: *Thermophilic bacteria, *Farm wastes, Industrial wastes, Oxidation, Aerobic bacteria.
Identifiers: Mesophilic bacteria, Pasteurization, Substrates.

Disposal of substrates with high amounts of pathogenic bacteria and oxidizable organic matter can be accomplished without polluting resources after proper stabilization, pasteurization, and deodorization. This is accomplished by heating them long enough to degrade the pathogenic bacteria and organic matter. The heat is provided by exothermic reactions in aeration tanks to which the sludge has been added. The sludge must be continually recirculated to aid mesophilic and/or thermophilic bacteria and to provide an oxygen balance in the circulating liquid. Exothermic reactions heat the substrates up to 65-70 degrees centigrade which accelerates the rate of degradation of the organic matter and pasteurization of the substrates. Also large quantities of humus compounds are produced during the oxidation. This process can be used on highly concentrated substrates with a high $BOD_5$ such as sewage sludge, liquid manure from animals, or industrial waste. (Russell-East Central).

### 1668-B2, B5, C2, D3, E2
### NITROGEN TRANSFORMATION DURING AEROBIC DIGESTION OF DAIRY CATTLE MANURE
A. C. Chang.
PhD Thesis, Department of Agricultural Engineering, Purdue University, Lafayette, Indiana, January, 1971, 116 p. 30 fig. 46 tab. 48 ref.

Descriptors: *Nitrogen, *Aerobic digestion, *Cattle, *Dairy industry, *Farm wastes, *Waste treatment, Water pollution, Denitrification, Chemical oxygen demand, Ammonia, Nitrates, Nitrites, Sampling.
Identifiers: *Manure, Land disposal.

Because of the high content of nitrogen in livestock waste and because of the possibilities of pollution by nitrogen, this study was undertaken. The fate of nitrogen during aerobic digestion of dairy cattle wastes was investigated. Also, the study was designed to seek a possible way of removing nitrogen before final disposal. Results indicated that dairy cattle wastes can be stabilized by aerobic digestion. Analyses also showed that temperature has a significant effect on the total nitrogen and stability of the digested wastes at the 5% level. It was concluded that nitrogen loss during aerobic digestion was due to volatilization of ammonia and the nitrification-denitrification sequence. After digestion was complete, the inorganic nitrogen in the heavily treated cattle waste can be removed by denitrification. However, this denitrification must be aided by a sufficient supply of organic substrate and some acclimated sludge. The overall efficiency of total nitrogen removal on a daily feed is 78.8% with the use of glucose as organic substrate and is 36.22% with the use of a dairy cattle manure slurry as organic substrate. (Russell-East Central).

### 1669-A9, A10, B5
### TOXICITY TO FLY LARVAE OF THE FECES OF INSECTICIDE-FED CATTLE
Entomology Research Division, Agricultural Research Service, United States Department of Agriculture, Corvallis, Oregon.
G. W. Eddy and A. R. Roth.
Journal of Economic Entomology, Vol. 54, No. 3, p. 408-411, June, 1961. 3 tab, 7 ref.

Descriptors: *Toxicity, *Larvae, *Farm wastes, *Cattle, *Insecticide.
Idenitfiers: *Flies, *Feces, *Insecticide-fed cattle.

Twenty-five insecticides were tested for their effectiveness against the larvae of feces-breeding flies. The cattle were given a ration of feed and insecticides for five days. Bayer 22408 and Co-Ral, proving lethal at 1.0 mg. per kg. of animal weight, were most effective compounds were also added to fresh manure to determine minimum lethal concentrations. Larval toxicity was determined at lethal and sublethal levels of dosage. There was a wide range of effectiveness for the insecticides tested. (Frantz-East Central).

### 1670-A9, A10, B5
### TOXICITY TO FACE FLY AND HOUSE FLY LARVAE OF FECES FROM INSECTICIDE-FED CATTLE
Agricultural Research Service, United States Department of Agriculture.
Journal of Economic Entomology, Vol. 54, No. 3, p. 406-408, June, 1961, 5 fig. 1 tab.

Descriptors: *Toxicity, *Larvae, *Farm wastes, *Cattle, *Insecticides.
Identifiers: *Flies, *Feces, *Insecticide-fed cattle,

An experiment was conducted to determine larval development of face flies (Musco autoumnalis DeGree) and house flies (Musca domestica L.) in the feces of cattle fed a grain and insecticide ration. Co-Ral and Bayer 22408 were administered for 5 days at rates of .5 and 1.0 mg per kg. of cattle weight. Ronnel was administered at rates of 2.5 and 5.0 mg/kg. The feces was infested with both face fly and house fly larvae. Both Co-Ral and Bayer 22408 inhibited larval development at both dosage levels. Ronnel was effective against both species' larvae at the higher level and effective against face flies at the lower level. (Frantz-East Central).

### 1671-A2, B1
### PERFORMANCE OF FEEDLOT RUNOFF CONTROL FACILITIES IN KANSAS
Agricultural Engineering Department
Kansas State University
Manhattan
J. K. Koelliker, H. L. Manges, R. I. Lipper.
Presented at 1974 Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4012, 17 p. 2 fig. 3 tab., 9 ref.

Descriptors: *Feed lots, *Runoff, *Control, *Kansas, *Models, Performance, Design, Disposal, Irrigation.
Identifiers: *Watershed.

A continuous watershed model utilizing daily inputs has been developed to evaluate expected performance for feedlot runoff control facilities for Kansas conditions. In Kansas, runoff control structures sized to contain the entire volume of the 10-year and 25-year 24-hour precipitation from the feedlot and dispose of 10 percent of the design volume per disposal day would control from 9.13 to 99.4 and 43.0 to 100.00 percent, respectively, of all runoff from an unsurfaced feedlot from east to west across the state. About one-third of the average precipitation in Kansas is expected to run off of an unsurfaced feedlot while about forty-four percent is expected to run off of a surface lot. Based upon results of this watershed model, evaporation pond sizes to provide as good or better control for Kansas than land disposal systems would be 6 feet deep for a surface area 120 percent of the minimum surface area and 4 feet deep for a surface area 150 percent of the minimum surface area. Use of this watershed model allows prior evaluation of various alternative systems for both the level of pollution control expected as well as management feasibility. (Cartmell-East Central).

### 1672-A8, 12, E2
### EFFECT OF APPLYING SWINE FECES ON SOIL AND PLANT MINERAL LEVELS
J. D. Hedges; E. T. Kornegay, and D. C. Martens.
Livestock Research Report, Research Division Report 153, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, July, 1973, p. 1-7, 4 tab,

Descriptors: Hogs, *Farm wastes, *Waste disposal, *Soils, *Copper, Sampling, Rates of application, Potassium, Phosphorus, Zinc, Calcium, Hydrogen ion concentration.
Identifiers: *Swine, *Manure, *Plant mineral levels, Land spreading.

Manure collected from finishing hogs fed rations with and without copper was spread on silt loam soil to determine the effect on the growth and mineral composition of corn and on the movement of these minerals in the soil. Manure was applied at the rate of 6.9 tons per acre between rows when corn was four inches tall. The copper content of the control feces was 88 ppm as compared to 1460 ppm for the high copper feces. Results from the high copper feces area indicated that the copper increased substantially in the soil but only slightly in the corn ear leaf. During the one growing season copper did not appear to move down in the soil. Phosphorus, calcium, and magnesium content of the soil increased with no change in the amount of magnesium and calcium in the plants. There were no changes in the levels of potassium, zinc, and iron in the soil or plants. Phosphorus appeared to move down while magnesium and calcium remained in the surface of the soil. (Russell-East Central)

### 1673-A11, B2, C2
### TROUT METABOLISM CHARACTERISTICS AND THE RATIONAL DESIGN OF NITRIFICATION FACILITIES FOR WATER REUSE IN HATCHERIES
Department of Civil Engineering
Texas University
Austin
R. E. Speece
Transactions of the American Fisheries Society, Vol. 102, No. 2, p. 323-334, April, 1973. 14 fig. 12 ref,

Descriptors: *Trout, *Metabolism, *Data collections, *Design, Nitrification, *Facilities, *Water reuse, *Fish hatcheries, Oxygen requirements, Ammonia, Suspended solids, Temperature, Feeding rates, Biochemical oxygen demand.
Identifiers: Nomograph.

This paper is an attempt to bring together the available information on trout metabolism and nitrification with the objective of establishing a rational procedure for the design of nitrification facilities for water reuse in trout hatcheries. The same rationale as used in this paper can be used for other types of fish through the use of the appropriate ammonia production, oxygen requirement, and water requirement data. Data have been taken from the literature on trout culture to mathematically define the ammonia production, oxygen requirements, BOD and SS production, water requirements, and loading rates as a function of trout length and water temperature. The temperature dependence of feeding rate and nitrification capacity has been incorporated into a nomograph which predicts the nitrification volume requirements for recycling. Another nomograph was constructed to predict water flow requirements and pollution resulting from trout hatchery operation. (Cartmell-East Central).

### 1674-A6, B2, D3, F1
### NOW, NO ODOR WASTE HANDLING
Swine editor.
R. J. Fee.
Successful Farming, Vol. 71, No. 9, p. K14, August, 1973. 2 fig.

Descriptors: *Odor, *Waste treatment, *Hogs, *Farm wastes, Centrifugal pumps, Sewage, Costs, Effluents, Iowa.
Identifiers: Pits.

A new concept in odorless waste handling for hogs is being used on the Orville Luedtke farm in Iowa, The basic principal of the Rem-Ox system is that it uses atmospheric oxygen to maintain and aerobic condition in the waste for fast, odor free organic material digestion. All waste treatment is done within the building, using centrifugal force, circulating sewage pumps to agitate and aerate the material in the pits. Unlike other confinement operations, the "racetrack design" pits in the Luedtke's system can be much more shallow than usual. The centrifugal force sewage pumps are placed at strategic locations to propel the effluent in a circular fashion around the building. Cost depends on the size and type of structure. Sizing of pumps and motors is based primarily on the daily animal manure input into the system. (Cameron-East Central).

### 1675-A11, B2, C2, D3

### NUTRITIVE VALUE OF AEROBICALLY SUSTAINED SWINE EXCREMENT

Illinois University
Urbana-Champaign
B. G. Harmon
Journal of Animal Science, Vol. 34, No. 3, p. 403-407, 1972. 1 fig. 7 tab, 12 ref.

Descriptors: *Nutrients, *Swine, *Farm wastes, Aerobic conditions, Oxidation lagoons, Proteins.
Identifiers: *Excrement.

The aim of this study was to measure the nutritive value of solid residue collected from aerobically-maintained swine excrement present in an oxidation ditch. Four studies were conducted with the solid precipitate of aerobically sustained swine waste. Settled solids (ODR) collected from an oxidation ditch and containing 27.7% protein were substituted for other protein sources in studies with weanling rats. The protein of ODR could replace one-third to one-half of the protein of casein or soybean meal and support similar weight gains although gain/feed ratio decreased as ODR was increased in the diet. Feed intake was not reduced by the addition of ODR in any of the studies. The protein and energy digestibility values for ODR was less than those for the casein containing basal diet. The addition of lysine or tryptophan individually to a corn-ODR diet did not influence gain while the combination significantly increased gain and gain/feed suggesting that these amino acids were most limiting and nearly equally limiting in that diet. (Cartmell-East Central).

### 1676-A11,B1,C2,D1,D3,E3

### ORGANIC FERTILIZER OFFSHOOT OF POLLUTION-FREE FEEDLOT

Anonymous
Feedlot Management, Vol. 15, No. 13, p. 9-12, December, 1973, 4 fig.

Descriptors: *Fertilizers, *Pollution, *Feed lots, *Cattle, *Farm wastes.
Identifiers: *Organic fertilizer, *Digester, Disease control.

The Ohio Feed Lot Inc. is developing the first animal waste, large scale sterilized organic fertilizer. By means of a digester, a machine capable of circulating air through the accumulated manure, Ohio Feed Lot is speeding up nature's aerobic process. The digester, housed in a 700 by 120 ft. pre-coated galvanized steel building, is fed 400 tons of manure daily. The manure is collected by front-loading tractors and dumped into large vats where high-power fans circulate the air, inducing heat to aid the digester in speeding up the process by months. Once sterilized, the manure is packaged ready for use. With eight steel roofed pen buildings, the Ohio Feed lot, eliminates one problem or rural water pollution — runoff caused by an effluent of cattle feces and urine. The mixture of feces and urine gives off two gases, ammonia and carbon dioxide. To control the ammonia level, the buildings are placed to give a maximum drying and cooling effect. Natural air is maintained in the barns. The use of an enclosed environment has also completely self-sustaining environment—and a completely ecology-proof environment. (Cameron-East Central).

### 1677-A9, A10, B1, F6

### FEED ADDITIVES FOR CONTROL OF HOUSE FLY LARVAE IN LIVESTOCK FECES

Fort Hays Branch
Kansas Agricultural Experiment Station
Hays
T. L. Harvey and J. R. Brethour.
Journal of Economic Entomology, Vol. 53, No. 5, p. 744-776, October, 1960. 4 tab, 12 ref.

Descriptors: *Feeds, *Larvae, *Farm wastes, *Livestock, *Cattle.
Identifiers: *Feed additives, *House fly larvae, *Feces, Musca domestica L.

This investigation was to test Polybor 3 as an additive to a steer ration for control of house fly larvae in feces. Control of house fly larvae was obtained in steer manure treated with Polybor 3 at one gm/kg but not at half this rate. Polybor 3 fed at rates up to 100 gm/head day to a steer weighing about 700 lbs., resulted in no significant control of house fly larvae in manure. Spores mixed directly with steer feces at a rate of 300 mg/kg prohibited fly development (egg to adult) and 100 mg/kg reduced it significantly. No effect on fly development was evident in manure treated at 50 mg/kg. The development of house flies was prevented in feces from a steer fed 20 gm of B. thuringiensis spores/day. Feed intake of this steer did not appear to be affected by including spores at this rate in the ration. Although the ration included 72 mg of aureomycin/day, this did not nullify the effect of B. thuringiensis on development of house flies in feces. Aureomycin did not decrease the pathogenicity of B. thuringiensis for house flies. (Cartmell-East Central).

### 1678-A4, B1, F2

### LOCATING A NEW FEEDLOT

Extension Agricultural Engineer
Nebraska University
Lincoln
E. A. Olson
Cooperative Extension Service Report GPE-5/01, University of Nebraska, Lincoln, 4 p. 5 fig.

Descriptors: *Feed lots, *Locating, Farm wastes, Water pollution, Livestock, Regulation, Zoning, Topography, Water supply, Transportation, Marketing.

The selection of a site for a livestock feedlot directly affects the success of the feedlot. Factors to consider in choosing a feedlot location include: environmental considerations, streams, topography, water supply, land area, towns and zoning laws. Other items include a source of livestock and feed, transportation (roads), and marketing facilities. Finally the operator must determine the size to build with provision for expansion. (Cartmell-East Central).

### 1679-A3, A5, A8, B2, E2

### TREATMENT AND DISPOSAL OF LIVESTOCK LAGOON EFFLUENT BY SOIL PERCOLATION

P. H. R[illegible]th.
M. S. Thesis, Dept. of Agricultural Engineering, Iowa State University, 1966, 116 p. 6 fig, 2 tab, 72 ref.

Descriptors: *Waste treatment, *Waste disposal, *Livestock, *Lagoons, *Effluent, *Soils, Percolation, *Infiltration, Liquid wastes, Organic wastes, Water pollution, Permeability.
Identifiers: *Land disposal.

Treatment of liquid livestock wastes by soil percolation is a possible means of disposing of huge supplies of wastes. However, to be effective, soil percolation must deal with factors such as (1) the rate at which the wastewater can be applied without significant runoff, (2) the frequency of application most favorable to maintenance of the agronomic usefulness of the land, (3) the seasonal variation, (4) the degree of assurance that the quality of the ground water will be impaired due to excessive seepage, and (5) the equipment needed. In view of the information which has resulted from this investigation, it is evident that actual field applications of soil percolation will be necessary to determine if soil percolation is feasible or sound to use in the long run. However, this study gave promising results for soil percolation and no significant drawbacks were encountered. (Russell-East Central).

### 1680-A8, B2, C1, C2,E2

### EFFECT OF FEEDLOT LAGOON WATER ON SOME PHYSICAL AND CHEMICAL PROPERTIES OF SELECTED KANSAS SOILS

D. O. Travis.
P.H.D. Dissertation, Department of Agronomy, Kansas State University, Manhattan, 1970, 97 p. 12 fig, 26 tab, 93 ref.

Descriptors: *Feed lots, *Lagoons, *Soil chemical properties, Soil physical properties, Kansas, *Soil cores, Farm wastes, Waste disposal, Waste treatment, Irrigation, Infiltration rates, Nitrogen.
Identifiers: *Lagoon water, Dilution.

Cores from four Kansas soils were treated under unsaturated flow conditions with lagoon water collected as runoff from a Kansas State University experimental feedlot. This was done in order to determine the probable effects of applying such material to the soil as supplemental irrigation water and as a means of water disposal. Soil cores were collected and analyzed while in the natural state. Additional cores were collected and treated with the lagoon water. Changes in the infiltration rate while the lagoon water was percolating through the soil cores were measured and recorded. The resulting filtrates were analyzed for their chemical constituents during the duration of the experiment. An examination of these treated cores at the end of the experiment indicated a greatly increased monovalentcation concentration (especially Na) and an increased total nitrogen concentration within the soil resulting from the lagoon-water treatments. Dilution is proposed as a solution for this waste disposal problem. (Cartmell-East Central).

### 1681-B2,B3,B4,D1,D3,E2

### ANIMAL WASTE MANAGEMENT-PROBLEMS AND GUIDELINES FOR SOLUTIONS

Department of Agricultural & Civil Engineering
Cornell University
Ithaca, New York 14850
R. C. Loehr
Journal of Environmental Quality, Vol. 1, No. 1, p. 71-78, Jan.-March, 1972. 2 tab, 11 ref.

Descriptors: *Farm wastes, *Management, *Confinement pens, Livestock, Waste treatment, Waste disposal, Legal aspects, Liquid wastes, Solid wastes.
Identifiers: Animal wastes, *Guidelines, Land disposal.

Increased efficiency of agricultural production has caused new environmental problems for agriculture. Confined animal production operations produce large volumes of animal wastes for disposal. The most satisfactory solutions for animal wastes include some type of initial treatment (natural drying systems, aerated liquid systems, runoff control measures, waste holding units) followed by land disposal. The long term approach for animal production must be based upon both optimal production of the product and on maintenance of acceptable environmental quality not only to the animals and the producers, but to society as a whole. (Merryman-East Central).

### 1682-B2, B3, B4, E2, F1

### POLLUTION ABATEMENT SYSTEMS FOR FARM ANIMAL WASTES IN SOUTHEAST MICHIGAN

Area Engineer
Ann Arbor, Michigan
B. E. Boesch and D. F. Kesselring
Presented at the 1973 Annual Meeting, American Society of Agricultural Engineers, University of Kentucky:, Lexington, June 17-20, 1973, Paper No. 73-414, 13 p. 2 ref.

Descriptors: *Farm wastes, *Michigan, *Pollution abatement, *Waste treatment, *Waste disposal, *Waste storage, *Design, Equipment, Costs, Livestock, Feed lots, Lagoons, Irrigation, Construction costs.

Seventy-nine pollution abatement systems for farm wastes were installed in southeast Michigan during 1970 to 1972. The systems varied greatly in size, but they can be categorized into farm functions: diversion, collection, storage, and disposal. The systems used to perform these functions are discussed. Included in the discussion are: liquid manure tanks, holding ponds, semiliquid manure storage units, solid storage units, earthen holding pits, conventional manure-handling equipment, tanker wagons, and spray distribution systems. Actual design, construction, costs, and guidelines for these waste management systems are given. (Frantz-East Central).

## 1683-A6, A11, B1, B4

### PERFORMANCE OF EXPERIMENTAL CLOSE-CONFINEMENT (CAGED) CATTLE FEEDING SYSTEMS

Agricultural Engineering Department
Oklahoma State University
Stillwater
G. W. A. Mahoney, G. L. Nelson, and S. A. Ewing.
Transcript No. 67-405 presented at the 60th Annual Meeting, American Society of Agricultural Engineers meeting jointly with the Canadian Society of Agricultural Engineering, Sasakatoon, Saskatchewan, June 27-30, 1967, 20 p. 12 fig. 5 tab.

Descriptors: Performance, *Feed lots, *Confinement pens, *Cattle, Farm wastes, Waste storage, Waste disposal, Odor.
Identifiers: *Close confinement feeding systems.

The objectives of this test were to determine the performance of cattle in crowded housing and to develop design parameters for confined housing facilities for cattle. Cattle behavior, activities, and health were studied extensively. The following results were noted: (1) Cattle limited to 15 square feet of slatted floor space required 20 percent more feed per pound of gain than cattle allowed 25 square feet of slatted floor space, or cattle in dirt lots with 100 square feet of space per animal, Daily rate of gain was 20 percent and 34 percent less, respectively. (2) Some sore feet were noted on animals on concrete slotted floors but this condition seemed to pass without incident and no detrimental effects were noted. (3) No preference was shown by the animals for any particular grid slat and slot width configuratioq. All four combinations tested performed well, with the 1 3/4 inch slots performing best in freezing weather. The wide slat and slot configuration, 5 inch slat with 1 3/4 inch slot, was the most economical to construct. (4) Animal waste accumulated at the rate of 0.3034 cubic feet per head per day. When the liquid portion was allowed to drain out of the pits, the accumulation rate was 0.2212 cubic feet per head per day. However, the latter wastes proved difficult to pump and this practice, of draining the pits, would prove costly in both time and equipment in cleaning. (Wetherill-East Central).

## 1684-B1, B5, C1, C2

### OUTDOOR BEEF CATTLE FEEDLOTS —PROPERTIES OF MANURE ACCUMULATIONS

Department of Agricultural Engineering, Nebraska University, Lincoln
C. B. Gilbertson, J. R. Ellis, J. A. Nienaber, T. M. McCalla, and T. J. Klopfenstein.
Presented at the 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 20 p. 5 fig. 5 tab, 11 ref.

Descriptors: *Farm wastes, *Feed lots, Chemical properties, Physical properties, Nebraska, Nitrogen, Phosphorus.
Identifiers: *Beef, *Manure, *Surface slope, *Animal density, *Climatic conditions, Volatile solids.

Outdoor beef cattle feedlots were constructed with 3, 6, and 9% slopes at the University of Nebraska Field Laboratory to study the characteristics of wastes. The results of this four year research show that the physical and chemical characteristiecs are affected by surface slope, animal density, and uncontrollable climatic conditions. The slope did not have a predictable effect on the average moisture content of material removed. Material was removed semiannually from the feedlot surface to the depth of the soil-manure interface. The total solids removed averaged 25 and 35% volatile for the 200 and 100 sq. ft./head lots, respectively. pH, nitrogen content, and phosporous content were also measured. Completely removal of material down to the soil-manure interface is not recommended because the large quantities of soil removed must be replaced. (Cameron-ECU)

## 1685-A11, A12, B2, C3, D3

### SURVIVAL OF SALMONELLA TYPHIMURIUM IN ANIMAL MANURE DISPOSAL IN A MODEL OXIDATION DITCH

L. A. Will, S. L. Diesch, and B. S. Pomeroy, American Journal of Public Health, Vol. 63, No. 4, p. 322-326, April, 1973. 1 fig. 2 tab, 21 ref.

Descriptors: *Salmonella, *Farm wastes, *Livestock, *Waste disposal, *Oxidation lagoons, Cattle, Pathogenic bacteria, Model studies, Effluent, Sludge, Measurement.
Identifiers: *Survival, Seeding

In order to evaluate the potential health effects of pathogens in cattle manure, research was conducted in a laboratory model oxidation ditch to measure salmonella survival time, to develop and improve bacteriologic methods of measurement of detection and survival of pathogens in beef cattle manure, Salmonella typhimurium survived for 17 days post seeding in the model oxidation ditch at summer temperatures. The microorganism survived for 47 days at winter conditions. The data indicated that survival is of greatest duration in the sludge portion of the settling chambers. Based upon results obtained, the three sampling methods, temporary swab, prolonged swab, and increment removal, were comparable in isolations made. The greatest success for measuring survival thus far has been achieved utilizing BG—Bile and Selenite-BG-sufadiazine as the enrichment phase, and SS and Selenite-BG-sulfadiazine the plating phase for isolation, Perhaps one approach to controlling the salmonella problem in animal manures is to chlorinate, or otherwise treat, the wastee emanating from confinemenet housing units. (Cartmell-East Central).

## 1686-A6, D3, F1

### AEROBIC TREATMENT OF POULTRY WASTES

J. H. Martin, R. C. Loehr, A. C. Anthonisen, and S. P. Nieswand.
Department of Agricultural Engineering, Cornell University, Ithaca, New York.
Presented at 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 35 p. 10 fig, 6 tab, 11 ref.

Descripteors: *Aerobic tereatment, *Farm wastes, *Poultry, Oxidateion lagoons, Odor, Construction, Operation and maintenance ,Costs.
Identifiers: Oxidation ditch.

The relaetionship between fundamental concepts and design criteria for the aerobic treatment of poultry wastes are presented. The results of an evaluation of a full scale oxidation ditch system were used to illustrate this relationship and to characterize the potential of erobic treatment for these wastes in terms of construction and operating costs. The full scale oxidation ditch system that was evaluated is located on a commercial poultry farm approximately five miles north of Ithaca, New York. The farm is owned and operated by Mr. Charles Houghton. The system consists of two interconnected ditches that were evaluated as a total system. A plan-view and cross-section of the Houghton facility are shown. Throughout the course of study, the Houghton Farm oxidation ditches have achieved the objective of odor control. The absence of complete nitrification, i.e. no residual mixed liquor ammonia, except for a brief period indicated inadequate oxygenation capacity. It was determined in laboratory studies that nutrifying organisms were present. A summary of the capital and operating expenses associated witeh the Houghteon oxidation ditches are given. (Cartmell-East Central).

## 1687-B2, B4, E2

### ABOVE GROUND STORAGE OF LIQUID MANURE

Department of Agricultural Engineering, Kentucky University, Lexington.
H. E. Hamilton, and I. J. Ross.

Descriptors: *Waste storage, *Liquid waste, *Design, Dairy industry, Operation and maintenance, Kentucky.
Idenetifiers: Liquid manure, *Above ground storage.

Presented at the 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 12 p. 4 fig.
Two experimental above ground liquid manure storage systems were installed at the University of Kentucky dairy research center in order to determine theoperating characteristics and design critria for farm applications. The 22,000 gallon tanks were constructed of chromized steel sheets. The design is basically the same as that used for high moisture grain storage Conventional manure pumps were modified and installed in a collection pit. Valving was arranged to allow agitation in the collection pit, pumping into the storage tank, or pumping to a spreader. All the systems functioned well except the nozzles inside the tanks. (Cartmell-East Central).

## 1688-A6,A10,B3,C1,C2,D3

### THE AEROBIC DECOMPOSITION OF SOLID BEEF CATTLE FEEDLOT WASTE

Martin, J. D.
M. S. Thesis, Texas Tech University, Lubbock, January, 1971, 30 p. 9 fig. 1 tab, 8 ref.

Descriptors: *Aerobic treatment, *Solid wastes, *Farm wastes, *Feed lots, *Cattle, *Waste treatment, Carbon, Nitrogen, Chemical oxygen demand, Decomposing organic matter, Temperature, Moisture, Phosphorus, Odor, Digestion.
Identifiers: *Composting, Flies.

The objective of this study was to determine the feasibility of waste stabilization by aerobic decomposition. The feedlots from which beef cattle waste was recovered were located on the Texas Tech University agricultural farms in Lubbock, Texas. Four different lot treatments were used in the study, Temperature, moisture, carbon nitrogen ratio, and phosphorous content affected the rate of digestion. Under proper, effective management, beef cattle feedlot waste can be successfully composted reducing raw feedlot manure to an innocuous material of low energy potential. Odors, as well as fly and maggot infestations, cease shortly after the process begins. The optimum moisture range of manure to be composted is from 30 to 50% The C/N ratio should exceed 30 to obtain optimum composting rates. Aeration rates should be maintained between 3 and 6 liter/min. per 100 kg. of waste or regulated to yield an 8 to 10 percent oxygen level in the exhaust gases. (Cartmell-East Central).

1689-B2, C2, D1, D3, E2, E3

### THE RENOVATION AND REUSE OF WATER FOR DILUTION AND HYDRAULIC TRANSPORT OF DAIRY CATTLE MANURE

R. E. Graves.
PhD Thesis, University of Massachusetts, Amherst, June, 1971, 120 p. 31 fig, 18 tab, 61 ref.

Descriptors: *Farm waste, *Cattle, *Dairy industry, *Water, *Hydraulic transportation, Water pollution, Chemical oxygen demand, Biochemical oxygen demand, Ammonia, Nitrates, Waste treatment, Liquid wastes, Phosphate, Chlorides, Slurries, Aerobic treatment.
Identifiers: *Renovation, *Reuse, *Dilution, *Screening.

Work was undertaken to evaluate the concept of pretreatment by screening combined with aerobic stabilization and reuse of water as they might apply to the hydraulic handling of dairy cattle manure. Performance of a stationary sloping screen for separating solid material from dairy manure slurries was evaluated using different bar spacings and different slurry mixtures. Two different systems were used to treat screen effluent. One system consisted of primary settling, aeration and final settling; the other of aeration and final settling. No adverse effects on the treatment systems were noted from the reuse of water. Screening of water-manure slurries removes a significant amount of material from the liquid and makes subsequent treatment and handling easier. Screen effluent may then be irrigated, stored aerobically, or treated to allow reuse for hydraulic cleaning. The addition of screening will improve the operation of many systems now used for treatment of animal manure slurries. (Russell-East Central).

1690-A2, A4, B2, C1, C2, D2, E1, E2, F6

### ZETA POTENTIAL OF COLLOIDAL SUSPENSION FROM A BEEF CATTLE FEEDLOT SURFACE

J. C. Lorimor.
M. S. Thesis, Agricultural Engineering Department, University of Nebraska, 58 p. 12 fig, 12 tab, 29 ref.

Descriptors: *Zeta potential, *Feed lots, *Cattle, Runoff, Water pollution, Hydrogen ion concentration, Irrigation, Waste treatment, Sampling, Temperature, Statistical models.
Identifiers: *Colloidal suspensions, Quadratic equations, Alum.

Runoff from beef cattle feedlots is one source of potential water pollution. Two alternatives are available to prevent feedlot runoff from polluting streams: (1) the water can be spread on agricultural land as irrigation water, or (2) it can be treated before it is released to the streams. Zeta potentials on colloidal solids in feedlot water samples were investigated as one method of treatment control. Zeta potentials were found to average -29.5 millivolts on untreated samples. The potentials varied with pH and solids concentrations according to theory. Particle zeta potentials were found to be controlled by chemical treatments and high chemical dosages were required to reduce the zeta potentials to near the isoelectric point. Also, quadratic equations could be written to accurately define the relationships between zeta potentials, chemical dosages, and solids concentrations. (Russell-East Central).

1691-A6, B1, B2, D1, D3, E1, F2

### NEBRASKA UNIVERSITY SECOND NATIONAL SYMPOSIUM ON POULTRY INDUSTRY WASTE MANAGEMENT

Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, 262 p.

Descriptors: *Poultry, *Farm wastes, *Waste disposal, Lagoons, Odor, Legal aspects, Equipment.
Identifiers: *Waste management.

Waste management is an issue that the poultry industry must be prepared to deal with. This Second National Symposium did a great deal to inform the poultry industry of current waste management alternatives. As expected, lagoons were discussed extensively throughout the symposium. Many problems such as poultry waste disposal on the farm, in the hatchery, and in the processing plants were discussed. Hydraulic manipulation of wastes was presented along with considerations of proper odor control. Information concerning legal, social, and economic aspects of waste management were also dealt with. Much more study and research is needed so that the poultry industry can better deal with the problems and changes of the future. (Russell-East Central).

1692-B2, C1, C2, D3, F3

### WASTE DISPOSAL CONCEPTS

Professor of Sanitary Engineering, Purdue University, Lafayette, Indiana.
D. E. Bloodgood,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 1-9.

Descriptors: *Waste disposal, *Farm wastes, *Poultry, *Lagoons, *Anaerobic digestion, Chemical properties, Design.
Identifiers: Loading rates.

The adoption of the anaerobic process for disposal of chicken manure in large production operations appears to be an excellent idea. Through the process of anaerobic digestion, the organic solids of the wastes are digested by anaerobic bacteria to ideally produce carbon dioxide and methane. Factors important in successful anaerobic digestion are: (1) pH; (2) alkalinity; (3) volatile acids; (4) nitrogen; (5) loading rates; and (6) temperature. Each of these factors is important in maintaining a proper balance in a lagoon. Lagoons can be constructed in a variety of shapes and sizes with a variety of methods for starting them initially. Poultry manure offers many variables to lagoon operation such as buildups of ammonium carbonate or hydrogen sulfide, and each lagoon will have a particular set of variables to deal with. More studies will be necessary to determine the lagoon's capabilities in digesting dead chicken feathers and chicken feeds. (Russell-East Central).

1693-A6, A10, A12, A13, B2, D3, F1

### PRINCIPLES AND PRACTICES OF AEROBIC TREATMENT IN POULTRY WASTE DISPOSAL: AEROBIC STABILIZATION PONDS

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
R. Porges,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 10-20, 1964, p. 23-43. 2 fig, 4 tab, 8 ref.

Descriptors: *Poultry, *Farm wastes, *Waste treatment, *Waste disposal, *Aerobic treatment, Design.
Identifiers: *Aerobic stabilization ponds, Loading rates.

will not be created; and legitimate water uses will be protected. Waste stabilization ponds are probably the best treatment tools for waters because they make use of natural biological reactions. In the aerobic type of ponds, algae produce oxygen which permits aerobic bacterial degradation of the organic material. Pond loading is an important factor which varies with climatic conditions. Pond size and depth are also variable. Estimates of aerobic pond capabilities state that one acre of an aerobic pond will provide adequate treatment of manure wastes from 3,000 chickens. More data is accumulating about aerobic ponds, and although they are not the answer in every case, they do provide the poultry farmer with a valuable and economic tool for waste disposal. (Russell-East Central).

1694-A6, B2, B4, D1, D3

### ODORS AND THEIR CONTROL

Barnebey and Chaney, Columbus, Ohio.
O. L. Barnebey,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 57-65.

Descriptors: *Odor, *Control, *Equipment, *Poultry, *Farm wastes, *Waste treatment, Anaerobic conditions.
Identifiers: Feathers.

Odor is a perplexing and burdensome problem to the poultry farmer. It is difficult to solve and often expensive. There are five main problems to be dealt with to help curtail odors. The first is general housekeeping. The excrement from the poultry undergoes anaerobic reactions and noxious odors are produced which should be pumped into a digester. The second problem is feathers. The feathers should be promptly removed to eliminate buildup. The third problem is odor from cooking feathers and dryer gases. These odors or gases should be piped into scrubbing towers. The fourth problem is feather meal dust. This dust should also be piped to the scrubbing tower to remove odors. The fifth problem is holding ponds for the waste. This is the area most subject to public condemnation and should not be used if possible. After the problems are identified, the poultry farmer should then select the equipment which would best eliminate the odors from his particular operation. (Russell-East Central).

1695-A6, D1, D2, D3, F2

### IDENTIFICATION AND CONTROL OF ODORS FROM ANIMAL WASTES

Livestock Farm Advisor, Agricultural Extension Service, California University.
C. A. Perry,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 67-73.

Descriptors: *Odor, *Control, *Farm wastes, Anaerobic conditions, Aerobic conditions, Feed lots, Cattle, Waste treatment.
Identifiers: *Animal wastes.

Animal wastes produce noxious odors when they undergo anaerobic digestion. On the other hand, little or no odor is produced by aerobic digestion. However, to accomplish aerobic digestion in a cattle feedlot, some sort of mechanical agitation must be employed. In Pomona, California, odor from two cattle feedlots outside of town was a source of complaint. To prevent legal problems, the feedlots began to remove accumulated wastes, to use chemicals to control odors, and to mechanically agitate wastes with a harrow to promote aerobic bacteria. An odor panel in Pomona was started to keep records of odors. The odor panel kept records for a year with few reports of feedlot odor during the last few months. Pomona now gets few complaints from citizens about feedlot odors. Good management is probably the most important factor in odor control. (Russell-East Central).

## 1696-B2, C2, D3

### ANAEROBIC LAGOONS: THEORY AND PRACTICE

Agricultural Engineering Research Division, Agricultural Research Service, United States Department of Agriculture.
H. J. Eby,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 77-91. 1 fig, 2 tab.

Descriptors: *Lagoons, *Anaerobic conditions, *Design, Biochemical oxygen demand, Waste treatment, Farm wastes, Sewage, Livestock.

The function of any lagoon, whether it be aerobic or anaerobic, is to reduce the BOD of the materials entering the lagoon. It is difficult to maintain a totally aerobic or anaerobic condition in a particular lagoon because so many variables exist which affect the microbial growth. Sewage treatment can be accomplished much more easily than farm waste treatment because sewage flow is regular and stable whereas the loading rate and flow of livestock waste is fluctuating and erratic. Recommendations for the proper design of an anaerobic lagoon are presented. These recommendations stress converting population equivalents to pounds of BOD. Also there are suggestions on the proper management and detention time of the lagoon. Research units have been devised to test the effectiveness of anaerobic lagoons in treating livestock wastes. (Russell-East Central).

## 1697-A4,A5,A7,A8,B1,F2

### SOCIAL AND LEGAL IMPLICATIONS OF ORGANIC WASTE MANAGEMENT

Chief, Division of Environmental Sanitation, California State Department of Public Health, Berkeley, California,
F. M. Stead,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 93-114.

Descriptors: *Organic wastes, *Management, *Legal aspects, *Public health, Environmental control, Waste treatment, Waste disposal.
Identifiers: Pollution.

In the past, Americans felt that the land was so vast and its resources were so great that nothing could ever overload the environment. Consequently, for years Americans poured wastes into the air, land, and water. Within the past few years, people have started to become aware that our natural resources must be protected. The environmental problem is extremely complex. Environmentalists have adopted the systems approach in hope of controlling the environment, because our resources such as water, air, and land must be preserved. The question is—who is to decide what shall be done? Should it be the courts, the people, or scientists? The legal aspects of curtailing pollution are unprecedented and difficult to establish, but they must be established. The environment must become regulated by man because it is dominated by man. Organic waste is essential and vital to man's existence, and the future holds dim prospects if man does not begin now to solve these problems. (Russell-East Central).

## 1698-A6, A10, B2, B4, D1

### HYDRAULIC COLLECTION OF POULTRY WASTE

Department of Agricultural Engineering, Cornell University, Ithaca, New York,
D. C. Ludington, and A. T. Sobel,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 115-135. 5 fig, 1 tab.

Descriptors: *Poultry, *Farm wastes, Waste storage, Waste treatment, Odor, Design, Cleaning.
Identifiers: *Hydraulic collection, Storage pits.

Hydraulic waste control systems offer many possibilities to the poultry farmer. Hydraulic collection of wastes reduces odors and permits scheduled cleaning. Hydraulic systems reduce labor requirements, lower fly production, and give more uniform indoor temperatures. The biggest advantage of hydraulic waste control is flexibility in the cleaning system, but cleaning cannot be accomplished efficiently without mechanical assistance. The pits which contain the waste should be confined by walls and limited to three feet in depth for safety and ease of cleaning. As in most processes, the hydraulic system does have disadvantages. The major one is the amount of material that is handled. Since dilution is required, more material must be handled with the hydraulic system than with other systems. (Russell-East Central).

## 1699-A6, A10, B2, E2

### HYDRAULIC MANURE HANDLING IN LAYING HOUSES

Extension Poultryman, Cornell University, Ithaca, New York,
C. Ostrander,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 137-147.

Descriptors: *Hydraulics, *Farm wastes, *Poultry, *Waste treatment.
Identifiers: *Manure.

There is no one cure-all system of waste disposal that can be used in all poultry situations. However, it appears that hydraulic handling of liquid wastes will work satisfactoritly in many situations. Hydraulic collection provides flexibility in time of cleaning, reduction of odors, reduction of labor, reduction of mechanization, control of flies, and control of temperatures in the poultry house. The system itself is not a lagoon and does not reduce or digest the wastes. The main disadvantage is that the system does not dispose of the manure, and it must still be hauled away and spread on land. Hydraulic systems have no place in a poultry operation which involves dehydration or incineration. It appears, however, that the advantages greatly outweight the disadvantages in making the hydraulic handling of poultry manure an effective means of waste disposal. (Russell-East Central).

## 1700-A6, B2, B4

### HYDRAULIC MANURE SYSTEMS

Chairman, Poultry Science Department, Nebraska University, Lincoln.
J. L. Adams,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 149-159. 1 fig, 1 tab.

Descriptors: *Hydraulics, *Waste treatment, Waste disposal, Odor, Design, Cleaning, Waste storage, Liquid Wastes.
Identifiers: *Manure, Fly control.

The need for good methods of waste storage, transportation, and disposal is greater than ever before. Hydraulic systems provide many answers to the poultry man's problems. Investigators have determined that poultry waste contains about 80% water; thus making it an excellent substance to be handled hydraulically. It has also been found that a simple diaphragm type pump is sufficient for moving large quantities of manure with up to 20% solids. Difficulties of hydraulic systems are the odors produced, the difficulty of disposing of the liquid manure after it has been collected. However, the advantages are flexibility of time of cleaning, ease of handling the manure, less possibility of noxious gases, control of flies, relatively inexpensive equipment, and control of constant temperatures. (Russell-East Central).

## 1701-B2, B4, D3, E2, F1

### LIQUID HANDLING PROCESSES FOR POULTRY MANURE UTILIZATION

Agricultural Engineering Department, Massachusetts University, Amherst.
C. A. Johnson,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 161-181. 3 fig, 10 ref.

Descriptors: *Liquid wastes, *Waste treatment, *Waste storage, *Poultry, *Farm wastes, *Stabilization, Septic tanks.
Identifiers: *Manure.

An integrated system concept for liquid manure handling that has been operating for a year and five months is described. This system was designed for a 7000 bird cage layer flock on the Rolland Congdor Farm in Longmeadow, Massachusetts. The system involves flushing the manure from under the cages to a large heated septic tank. The effluent from the septic tank is recycled to eliminate high water usage. This system provides ease of handling the manure. There are few moving parts with only a pump and motor operating about 20 minutes per day. No noxious odors are produced, and there is no manure accumulation pit or buildup. Water usage is relatively small since the effluent is recycled. Disposal of the manure is simple and seldom because a tank wagon can replace spreaders and irrigation systems can replace batch handling. Also the system is economical. The floating scraper and small pump can replace about $4,000 or more worth of mechanical cleaning equipment. With slight design changes and further experiments, it is hoped that this liquid manure system will become very profitable to use. (Russell-East Central).

## 1702-A1, B2, D4

### LAGOONS—SINK OR SWIM

Brender's Leghorns, Ferndale, New York.
M. Brender,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 183-192.

Descriptors: *Lagoons,. *Farm wastes, *Poultry, *Waste storage, *Waste treatment, Odor.

"Indoor" and "outdoor" "lagooning" are two methods often employed by poultry farmers for waste storage and treatment. With either type, the poultryman fights an odor problem. To prevent odor and to beneficially handle manure, the poultry man should catch manure in waterproof tanks; keep it covered with water at all times; move it out before it settles down; either haul it and spread it on crops or stabilize it in an outdoor lagoon; and move wastes by gravity. The author predicts that present and future research will solve many of the current lagoon odor, decomposition and pollution problems. (Russell-East Central).

## 1703-A9, B1, C5, E1

### HEALTH ASPECTS OF POULTRY WASTE DISPOSAL

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
C. W. Chambers, and N. A. Clarke,
Second National Symposium on Poultry Industry Waste Management, University of Nebraska Lincoln, May 19-20, 1964, p. 193-212. 18 ref.

Descriptors: *Farm wastes, *Waste disposal, *Public health, Bacteria, Fungi, Viruses, Diseases.

Interest in the disposal of poultry waste has stirred interest in the health aspects of poultry waste disposal. Many diseases are possibly communicable to man from poultry wastes. These diseases are caused usually by bacteria, fungi, or viruses. There are many avenues of transmission of the disease, such as direct contact with waste; ingestion of waste; inhalation of waste; and direct or indirect contact with vectors such as insects. Many diseases, such as those caused by the Salmonella species, can be transferred to man. To prevent the spread of disease, the poultry farmer should attempt to control conditions which result in multiplication of disease-producing organisms. The source of the disease-production should be eliminated if possible. The waste should be processed in a way which would breakdown the chain of infection. Above all, the poultry farmer should practice good management and remain rational about the subject of disease and disease potential. (Russell-East Central).

### 1704-A1, B1, F1, F2, F3
### SOCIAL, LEGAL, AND ECONOMIC CONSIDERATIONS OF ANIMAL PRODUCTION IN URBANIZED AREAS
Planning Director, Omaha, Nebraska.
A. Aust.
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 225-240.

Descriptors: *Poultry, *Management, *Legal aspects, *Economics, *Urbanization.

Within the last forty years, our country has undergone extensive urbanization. The poultry farmer or industrialist must face the ever growing urbanization of our society to effectively function in the world of today and tomorrow. There are three social developments which have been accentuated by urbanization that restricts the location of animal processing plants. These are: (1) the growth of large concentrations of people crowded together; (2) the tremendous technological advances of our society; and (3) the growing affluence, education, and cultural sophistication of our society. Because of these social changes many legal developments have taken place in the past few years. New legal restrictions or controls on the animal industry usually fall into four main categories: (1) planning controls; (2) public health controls; (3) public safety codes; and (4) aesthetic controls. Closely related to social and legal developments are the economic considerations affecting the locating of new processing plants and the operation of existing plants. There are three courses of action open to the poultry industrialist in terms of economics. These are: (1) the laissez-faire or do-nothing approach; (2) the self-sufficient approach; and (3) the good citizen approach is economically the best approach to the poultry man. (Russell-East Central).

### 1705-A1, B1, F4
### WHERE DO WE GO FROM HERE?
Extension Poultry Scientist, Federal Extension Service, United States Department of Agriculture, Washington, D.C.
W. R. Jenkins.
Second National Symposium on Poultry Industry Waste Management, University of Nebraska, Lincoln, May 19-20, 1964, p. 243-250.

Descriptors: *Poultry, *Waste disposal, *Water pollution, *Farm wastes, Research.

The future of the poultry industry is dependent on many factors. One of the most important factors that the poultry industry must deal with is proper waste disposal. Much has been dealt with in this symposium, but the poultry farmer should not mislead himself by believing that he has all of the answers. In the future, there will be increased concern about contamination of by-products, high quality water, and the disposal of large quantities of water. New and better systems of disposal will be devised, and it is hoped that the future will be bright for the poultry industry. (Russell-East Central).

### 1706-A2, C2, C3
### WATER QUALITY OF STORM RUNOFF FROM A TEXAS BEEF FEEDLOT
G. G. Wise III.
MS Thesis, Department of Agricultural Engineering, Texas A&M University, August, 1972, 166 p. 34 fig. 79 tab, 28 ref.

Descriptors: *Water quality, *Storm runoff, *Texas, *Feed lots, *Cattle, Sampling, Equipment, Chemical oxygen demand, Phosphorus, Nitrogen, Potassium, Sodium, Chloride, Slope, Waste treatment, Water pollution.

One of the major sources of pollution from high density beef feedlots is storm runoff. Efforts were made to determine the variation in chemical and physical properties of storm runoff from a beef feedlot area of Texas and to correlate the water quality variations with storm characteristics and hydrologic properties of the feedlot drainage area. The average concentrations of water quality parameters in the feedlot runoff did not change as much with variations in rainfall intensities, runoff rates, and runoff volumes as indicated by similar runoff studies. The concentrations of COD, phosphorus, and Kjeldahl nitrogen in the runoff were directly related to the total soils concentration. The concentrations of filterable solids, potassium, sodium and chloride were greater when the content lime between the surface and the runoff was increased. The higher average concentrations of total solids, COD, phosphorus, and Kjeldahl nitrogen; and lower average concentrations of filterable solids, potassium, sodium, and chloride from one area was due to the greater slope causing an increased sediment load and decreasing the contact time between the runoff and the feedlot surface. (Russeli-East Central).

### 1707-B2
### AN ECONOMIC EVALUATION OF LIQUID MANURE DISPOSAL FROM CONFINEMENT FINISHING HOGS
R. P. Kesler.
MS Thesis, Agricultural Economics Department, University of Illinois, 1966, 97 p. 8 fig. 25 tab, 38 ref.

Descriptors: *Economics, *Evaluation, *Liquid wastes, *Confinement pens, *Hogs, Lagoons, Waste disposal, Nitrogen, Illinois, Fertilizers, Costs, Equipment, Sampling, Analysis.
Identifiers: *Manure, *Hauling and spreading, Pollution.

Manure is a valuable by-product of the hog industry. When applied to cropland, the chemical, physical, and biological properties of the soil are improved. Animal wastes must be removed from confinement buildings if production is to continue, and this study dealt with three types of waste removal: (1) total hauling and spreading; (2) partial hauling and spreading and lagooning; (3) total lagooning. Based on the finding of this study, the conclusion can be made that total hauling and spreading and lagooning is the lowest net cost method of manure disposal. Partial hauling and spreading and lagooning is the second lowest net cost method of manure disposal, and total lagooning is the highest net cost method of disposal. Another conclusion is that the net cost of manure disposal, for all three methods, declines as the volume of hog production increases. The choice between hauling and spreading manure is still in the innovative stage of development. However, when cropland is available for utilizing the salvaged value of the manure as a replacement for commercial fertilizer, there appear to be strong economic considerations favoring the hauling and spreading method for disposal of hog wastes. (Russell-East Central).

### 1708-B2, D4, E2
### SOIL PERCOLATION AS A RENOVATION MEANS FOR LIVESTOCK LAGOON EFFLUENT
J. K. Koelliker.
MS Thesis, Department of Agricultural Engineering, Iowa State University, 1969, 108 p, 12 fig, 30 tab, 38 ref.

Descriptors: *Soils, *Percolation, *Livestock, *Lagoons, *Effluent, *Farm wastes, *Sprinkler irrigation, *Waste treatment, *Waste disposal, *Waste water treatment, Soil profiles, Hogs, Moisture, Chemical oxygen demand, Nitrogen, Phosphorus, Chlorides, Tile drains, Sampling, Iowa, Anaerobic conditions, Hydrogen ion concentration, Analysis.

A field experiment was operated from June through September, 1968, in central Iowa to study the use of a grass covered, Clarion-Webster silty clay loam soil profile as a treatment media for anaerobic manure lagoon effluent applied by sprinkler irrigation equipment. Effluent was applied at four loading rates—1.5 and 3.0 inches at 70% available soil moisture and 1.5 and 3.0 inches at 95% available soil moisture. Samples were collected on the surface, 3, 6, 12, and 30 inches deep in the soil profile, as well as from water flowing from the tile drains in each plot. Reduction in COD concentration was about 95% between the surface and the tile drains. Nitrogen concentration reduction was about 80%. Phosphorus concentration reduction was 99% in the top 3 inches of soil. The chloride concentration in the tile drainage water was reduced about 30%. The pH was reduced from 7.8 to 7.2 as the liquid percolated through the soil profile. No gross changes were observed in the soil where lagoon effluent was applied. The results indicated that a soil profile is an excellent treatment media for anaerobic lagoon effluent. (Cartmell-East Central).

### 1709-B1, C2, C5, D4
### NUTRIENT CHANGES IN POULTRY EXCRETA FERMENTED WITH RUMEN BACTERIA
Department of Agricultural Engineering, University of Kentucky, Lexington.
H. E. Hamilton, I. J. Ross, J. D. Fox, and J. J. Begin.
Presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-454, 18 p. 8 fig, 1 tab, 13 ref.

Descriptors: *Nutrients, *Farm wastes, *Poultry Fermentation, Nitrogen, Hydrogen ion concentration, Anaerobic conditions.
Identifiers: *Poultry excreta, *Rumen bacteria, Uric acid, Inoculum, Ether extract, Ash, Solids levels, Manure.

Proximate components and uric acid were measured in poultry excreta during anaerobic fermentation with rumen fluids as an inoculum. Nitrogen, ether extract, and ash were affected by pH and solids levels. There was an increase in the ether extract index at lower solids levels than for higher solids. Increasing the solids level or lowering the pH delayed the decomposition of uric acid. The uric acid was virtually decomposed after 22 hours at pH levels of 6.8 and 7.3 and 5 percent solids. The nitrogen, ether extract, and ash were also affected by the length of the fermentation period. (Cameron-East Central).

### 1710-A2, B1, C1, D1, E1
### MONITORING ON-FARM WASTE MANAGEMENT SYSTEMS
Extension Agricultural Engineer, Iowa State University, Iowa.
S. W. Melvin, D. H. Vanderholm, and J. C. Lorimor.
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, Paper No. 73-5542, 9 p.

Descriptors: *Monitoring, *Farm wastes, *Management, Hogs, Cattle, Feed lots, Runoff, Odor, Costs, Livestock, Corn Belt, Iowa.
Identifiers: Beef.

Research and demonstration sites were established to study waste management alternatives applicable in the Corn Belt. These sites were all commercial livestock operations including a wide variety of beef and swine handling systems. Among the data collected were runoff quality and quantity, waste characteristics, climatic data, cost data, and operating characteristics and problems. Results of the study showed that regular cleaning and maintenance of a low stocking rate in open feedlots results in pollutional strength of retained feedlot runoff of nearly 1/10 the pollutional strength of lots seldom cleaned, heavily stocked, and heavily packed with manure. Most debris basins or settling channels required a stabilized bottom of concrete or gravel to allow proper cleanout and maintenance. These sites have proved to be valuable resources in the animal waste management educational program carried on by Iowa State University extension staff. (Cameron-East Central).

## 1711-B1, C3, D4
### ANAEROBIC DIGESTER RESPONSE WITH DAIRY CATTLE MANURE
Agricultural Enigneer, Chicago Sanitary District.
J. L. Halderson, A. C. Dale, and E. J. Kirsch.
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, Paper no. 73-4532, 15 p. 6 fig, 2 tab, 21 ref.

Descriptors: *Anaerobic digestion, *Dairy industry, *Cattle, *Farm wastes, Chemical characteristics, Design.
Identifiers: *Manure, *Substrate, *Loading rates.

This study investigated the dynamic response of anaerobic digestion when that system was subjected to several levels of step rate changes in loading. Laboratory sized, four liter digesters, constructed of acrylic, maintained at 35°C, and continuously mixed were used to investigate the response when dairy cow fecal matter was the substrate. The units were batch fed once per day, with a 15 day detention time being maintained throughout the experiment. Dependent parameters measured were pH, total and volatile solids, total alkalinity, COD, gas production and composition, and total volatile acid concentration and composition. The experimental design consisted of a randomized block design with four factors and five levels of treatment. The fixed loading levels were considered to be the treatment with all other factors being held constant when possible. Individual digesters were nested within digester pairs and treatments. Results indicated that the biological system could respond in a satisfactory way to any of the applied tests of loading rates of waste. There were no storng indications that maximum loading rates or a maximum magnitude of step had been achieved. The responses of all the measured parameters are listed. (Russell-East Central).

## 1712-A1, B3, E2
### MOVEMENT OF MANURIAL NITROGEN IN COOL, HUMID CLIMATES
Agricultural Engineering Department, Cornell University, Ithaca, New York.
M. F. Walter, G. D. Bubenzer, and J. C. Converse.
67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No, 74-2018, 21 p. 10 fig, 4 tab, 14 ref.

Descriptors: *Model studies, *Nitrogen, *Nitrates, *Movement, *Anaerobic conditions, *Climates, *Farm wastes, Temperatures, Dairy industry, Crops, Ammonification, Nitrification, Denitrification, Soil moisture, Solutes.
Identifiers: *Manure, Ammonia volatilization, Ammonium fixation.

A quantitative computer model was developed to predict the vertical nitrate soil distribution resulting from heavy land applications of anaerobic liquid dairy waste applied to coarse textured soil. Parameters used in the model were developed for (1) soil with a deep water table, (2) soil temperatures of 0 to 20°C, and (3) soil matric potentials of 0 to -0.3 bars. Nitrogen immobilizations, ammonification, and nitrification were the primary transformations found to occur in the soil system. The two dominant forms of inorganic nitrogen found in these soil systems were ammonium and nitrate. Nitrate movement was based on predicted one-dimensional unsaturated flow and solute dispersion. Dispersion was assumed dependent on solute displacement but not on soil water velocity. (Cameron-East Central).

## 1713-A1, B1, C1, D1, E1, F1, F2, F4
### ANIMAL WASTE MANAGEMENT CONFERENCE
Iowa State University.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971.

Descriptors: *Farm wastes, *Management, *Livestock, *Confinement pens, *Waste treatment, *Waste storage, *Waste disposal, *Feed lots, *Economics, *Legal aspects, Lagoons, Runoff.

This conference was held in order to give an overview of animal waste management alternatives as they are practiced nationally, regionally, and by state. Animal waste characteristics, waste treatment facilities, waste disposal methods, and open lots vs housed confinement all come under close scrutiny. Legal and regulatory aspects of confinement are discussed. Activities of the Environmental Protection Agency, Soil Conservation Service, Agricultural Stabilization and Conservation Service, and Iowa Water Pollution Control Commission are discussed as well. (Merryman-East Central),

## 1714-B1, F1, F2, F4
### ANIMAL WASTE MANAGEMENT—COMMENTS ON THE NATIONAL SITUATION
Industrial Specialist, Environment Improvement, Agricultural and Natural Resources Division, Extension Service, United States Department of Agriculture.
K. R. Majors.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971. 7 p. 2 tab.

Descriptors: *Farm wastes, *Management, *Livestock, Feed lots, Confinement pens, Economics, Legal aspects, Technology.
Identifiers: *Animal wastes.

The character and magnitude of the problem of animal waste management; the impact of waste management and requirements of pollution control now mandatory for livestock producers; and the waste-management phase of livestock production are discussed. Agriculture does rank high as a generator of wastes—from both animal and crop production—but agriculture is unique in that it makes use of biological procedures almost entirely. The total animal waste figure is generally placed around two billion tons per year, or 55 million tons per day. Confinement housing systems for all animal production with quite different waste management systems than those for feedlots, must handle the same amount of waste per animal. Waste management and pollution control have become a concern in the livestock marketing system as well. Discussed briefly are various basic aspects of waste management including: technological requirements; regulatory requirements; economic factors; and social, political, legal, and related factors. Additional funds, expansion of activities, shifts in program emphasis, legislation for waste control, and cost sharing and broadening of provisions for financial assistance for feedlot operators are the key items desired by governmental agencies in order to make their programs more effective. (Cartmell-East Central).

## 1715-A2,A4,A5,A6,B1,F2
### THE STATE AND REGIONAL SITUATION
Extension Agricultural Engineer, Iowa State University, Ames.
S. W, Melvin.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 9 p. 6 tab.

Descriptors: *Feed lots, *Confinement pens, *Farm wastes, *Livestock, *Management, Water pollution, Odor, Fishkill, Runoff.
Identifiers: *Midwest, *Corn Belt.

The Midwest is now and will continue to be a great livestock-producing area in the future. Waste management problems have resulted from increased densities of animals in confinement. The water pollution hazard of many animal production units has been recognized. Regulations for control of this problem presently exist in most of the midwestern states. Odor is still a problem to many producers. The technology of animal waste management must develop rapidly to solve many of the producers' problems. (Cartmell-East Central).

## 1716-A1, B1, C1, C2, C3
### BIOLOGY OF WASTE MANAGEMENT
Department of Agricultural Engineering, Iowa State University, Ames.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971. 4 p. 3 fig.

Descriptors: *Biology, *Wastes, *Management, *Microorganisms, Bacteria, Algae, Protozoa, Metabolism.

This outline on the biology of waste management was prepared as a study aid for registrants at the Iowa State University Animal Waste Management Conference. The main topics of this outline were: bacteria, algae, protozoa and larger animals, bacterial physiology, population dynamics, environmental factors, food sources, hydrogen ion concentration (pH), trace nutrients, and temperature. (Cartmell-East Central),

## 1717-A6, B2, D3, F1
### AEROBIC WASTE TREATMENT
Department of Agricultural Engineering, Illinois University, Urbana.
D. L. Day.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971. 14 p. 3 fig, 6 tab, 4 ref.

Descriptors: *Farm wastes, *Waste treatment, *Aerobic conditions, *Oxidation lagoons, *Aerated lagoons, Municipal wastes, Design, Odor, Costs, Livestock.

Several forms of aerobic treatment relative to use in municipal waste treatment plants and adaptations for treatment of livestock metabolic wastes are discussed. Aerobic lagoons may be divided into two classifications, dependent upon the method of aeration: oxidation ponds (naturally aerated lagoons) and aerated lagoons (mechanically aerated lagoons). An oxidation pond is usually a shallow basin 3 to 5 feet deep for the purpose of treating sewage under climatic conditions (warmth, light, and wind) that promote the introduction of atmospheric oxygen and that favor the growth of algae to produce oxygen. An aerated lagoon is one that has a device that beats or blows air into the water with a portion of the oxygen being dissolved. The oxidation ditch is a modified form of the activated-sludge process. Aerobic bacteria use the organic matter in the waste as food for their metabolic processes, thus reducing the biologically degradable organics to stable material, with carbon dioxide and water as the major by-products. Design recommendations for in-the-building oxidation ditches are given. Some form of aerobic treatment is likely to be used in livestock waste management schemes because of the low level of odors associated with this method of treatment. (Cartmell-East Central).

## 1718-B2, B3, D1
### SYSTEM COMPONENTS TO SEPARATE SOLIDS AND LIQUIDS
Agricultural Engineering Department, North Dakota State University, Fargo.
G. L. Pratt.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 7 p. 3 fig.

Descriptors: *Solid wastes, *Liquid wastes, *Separation techniques, *Waste treatment, Feed lots, Livestock, Settling, Filtration, Centrifugation, Slurries.
Identifiers: Gravity flow.

The separation of solids from the liquid component of livestock manure adapts to many waste treatment and handling systems. Separation of these components is being introduced into systems where the material is separated prior to treatment as well as after the combined materials have undergone a treatment process. Two general methods are being used to accomplish the separation of manure components. These are settling and mechanical separation. In all devices that are used to settle solid materials from the liquid component of livestock waste. the velocity of flow of the liquid solid slurry is retarded to the point where sedimentation can occur. Concrete tanks and earth dugouts are being used for settling containers for the manure slurries. For runoff from feedlots, segregating the solid material from the liquids may be accomplished by settling channels. Mechanical separation includes filtration and centrifugation. Filtration of the combination solid liquid waste from livestock systems can often be designed to provide satisfactory installations. Advantages of the centrifuge are given. Gravity flow of liquids away from the solid manure is being investigated. Equipment improvements must be perfected before the system can be recommended. (Cartmell-East Central).

## 1719-B2, B3, B4, D1

### SWINE MANURE COLLECTION AND REMOVAL SYSTEMS

Extension Agricultural Engineer, Iowa State University, Ames.
L. D. Van Fossen.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15: 1971, 6 p.

Descriptors: *Hogs, *Farm wastes, Confinement pens, Labor, Hydraulic transportation, Lagoons, Cleaning.
Identifiers: *Swine, *Manure, *Collection, *Removal, Stockpiling, Slotted pits, Flushing tanks.

This publication outlines collection and removal systems for swine manure. The topics considered are: (1) hand cleaning, (2) mechanical cleaning, (3) pumps and stockpiling, (4) moving manure with a hydraulic head, (5) manure storage in the building, and (6) hydraulically handling manure. (Cartmell-East Central).

## 1720-A2,A4,A5,A6,C2,C3

### NATURE AND BEHAVIOR OF MANURE

Department of Agricultural Engineering, Iowa State University, Ames.
J. R. Miner.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 8 p.

Descriptors: *Farm wastes, *Water pollution, *Feed lots, *Runoff, Odor, Organic matter, Biochemical oxygen demand, Chemical oxygen demand, Nutrients, Microorganisms, Hogs, Gases, Confinemente pens.
Identifiers: *Manure.

This outline was prepared as a study aid to the registrants at the Iowa State University Animal Waste Management Conference. The major topics outlined are: (1) Manure as a potential water pollutant, (2) Feedlot runoff, and (3) Odor. (Cartmell-East Central).

## 1721-A2, B1, C2

### DESIGN CONSIDERATIONS IN FEEDLOT RUNOFF CONTROL

Extension Agricultural Engineer, Iowa State University, Ames.
S. W. Melvin.
Animal Waste Management Conference, Iowa State University, October 13-15, 1971, 5 p.

Descriptors: *Feed lots, *Runoff, *Control, *Design, *Farm wastes, Chemical characteristics, Waste disposal, Waste treatment, Iowa.

This outline of feedlot runoff pollution and control defines the following: (1) feedlot runoff, (2) problems caused by feedlot runoff, (3) factors affecting feedlot runoff quality, and (4) component design of runoff control facilities. Suggestions for minimizing feedlot complaints are listed. (Cartmell-East Central).

## 1722-B2,B3,B4,C1,C2,C3

### WASTE MANAGEMENT SYSTEMS FOR ROOFED BEEF CONFINEMENT FACILITIES

Agricultural Engineering Department, Minnesota University, St. Paul.
J. A. Moore.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 6 p. 1 fig, 1 tab.

Descriptors: *Farm wastes, *Management, *Cattle, *Confinement pens, Performance, Oxidation lagoons, Liquid wastes.
Identifiers: *Roofed beef confinement, *Waste management systems, Pollution control.

The major objectives considered when discussing a waste management system are pollution control, saving of labor, and an increase in animal productivity. The system may be divided into four components: collection, storage, treatment, utilization and/or disposal. In the discussion of roofed beef confinement, the facilities are divided into three categories: (1) environmental conditions (cold and warm units), (2) floor type (solid or slatted), and (3) moisture content of the waste (less than 1% to over 50% total solids.) The right types of confinement facilities discussed are dry solid cold, dry solid warm, dry slatted cold, dry slatted warm, liquid solid cold, liquid slatted cold, liquid solid warm, and liquid slatted warm. Climate has a direct relationship upon the selection of these systems. By listing objectives, properties of waste material, and the design of the system, an optimum design can be obtained. (Cameron-East Central).

## 1723-A11, B1, B4, B5, F1

### SWINE SYSTEMS FOR IOWA AND NORTH CENTRAL STATES

Extension Agricultural Engineer, Iowa State University, Ames.
L. D. Van Fossen.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 3 p.

Descriptors' *Hogs, *Farm wastes, *Management, *Iowa, Environmental control, Confinement pens, Waste storage, Waste disposal, Arrangement.
Identifiers: *North Central States, *Swine.

Before building a swine facility, the producer must compare the features of the alternate systems in order to select the ones most appropriate for his needs. The goal to develop successful swine facilities is to minimize extreme and uncomfortable environmental stress conditions that adversely effect pig performance; utilize natural pig habits to properly select the building features and operate the facility; and provide convenience for the swine producer. Items to be considered are: (1) level of environmental control, (2) environmental modifying systems, (3) manure collection and removal systems, (4) manure disposal systems, (5) feeding systems, (6) pen size, (7) animal and man access, (8) arrangement, (9) pen partitions, (10) building location, and (11) operating the system. (Cartmell-East Central).

## 1724-A3, A4, A5, A6, A7

### WASTE APPLICATION TO SOILS

Graduate Assistant in Agricultural Engineering, Iowa State University, Ames.
J. K. Koelliker.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 8 p.

Descriptors: *Farm wastes, *Application methods, *Soils, Fertilizers, Economics, Waste disposal, Water pollution, Nutrients, Bacteria, Odor, Soil contamination, Groundwater pollution, Denitrification.
Identifiers: Land spreading, Surface water pollution.

Manure disposal can cause air, water, or soil pollution. Air pollution may be caused by odors emitted during spreading or from manure left uncovered following spreading. Air pollution during spreading can be avoided by spreading only when meteorological conditions are favorable for good air mixing and when the wind will dissipate odors into an unpopulated area. Direct injection of liquid manure can eliminate nearly all odor during spreading. Surface water pollution is caused by inadequate incorporation of manure into the soil surface. Consequently, runoff from this soil may result in excessive organic load, excessive nutrients, and possible bacterial contamination of streams and lakes. Spreading on steep slopes, frozen or snow-covered ground, or flood plains should be avoided unless incorporation can be done immediately. Groundwater pollution may result from excess nitrogen and from bacterial contamination from farm wastes. Soil contamination may also result from manure disposal. Heavy manure applications can result in anaerobic conditions caused by rapid decomposition and excess soil water. Design criteria and recommendations are given for combatting these pollution problems. (Cartmell-East Central).

## 1725-A9, A11, C2, E3, F1

### ANIMAL WASTE REUSE

Extension Veterinarian, Iowa State University, Ames.
J. B. Herrick.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 4 p.

Descriptors: *Farm wastes, *Recycling, *Feeds, *Poultry, *Cattle, Proteins, Insecticides, Costs, Additives.
Identifiers: *Animal wastes, *Refuse, *Refeeding, Disease spread.

A great deal of concern is being generated over animal waste reuse or recycling. Animal scientists and agricultural engineers are scheming elaborate and complicated systems to reuse animal wastes. Recycling animal manure into feeds has provided one answer. While such feeds have been shown to have nutritional value, other factors need to be considered. The use of drugs, hormones, and antibiotics on the animals may have significant effects on animal wastes. Insecticides are sometimes present in manure to be refed to animals. The problem with animal waste reuse centers around cost; disease spread; and the effect feed additives will have on the animal when waste is reused. (Cartmell-East Central).

## 1726-A11, B1, B4, B5, F1

### EFFECT OF HOUSED CONFINEMENT ON ANIMAL PERFORMANCE

Extension Livestock Specialist, Iowa State University, Ames.
W. G. Zmolek.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 6 p. 4 tab.

Descriptors: *Confinement pens, *Cattle, *Performance, *Farm wastes, *Waste storage, Waste treatment, Runoff, Labor, Costs.
Identifiers: *Housed confinement, *Floor types.

At several experimental locations, individual facilities are in operation that control or modify the environment of beef cattle. From the data reviewed, it has been concluded that the housing of feedlot cattle increases their daily gain and decreases their feed requirements. Furthermore, there is little, if any, difference in cattle response to different types of housing and floor types. Therefore, the waste handling system selected will dictate the type of floor to use more than animal performance. Housed systems will continue to grow in use because of the several side benefits they offer. Some of these are: surface runoff of waste is eliminated; slotted floors eliminate the cost of bedding and labor; protection from sun and rain maintains the fertilizer value of the waste; less labor is needed to handle manure; cattle are more docile and easier to handle; less land is needed and site development is easier; less labor is required in yard repairs; cattle are cleaner; hired workers take more pride in a confined operation; and less labor is required for feeding and management. (Cartmell-East Central).

## 1727-B1, E1, F1

### ECONOMIC CONSIDERATIONS INVOLVED IN SELECTING TYPES OF CONFINEMENT AND WASTE DISPOSAL SYSTEMS FOR SWINE AND BEEF

Professor of Economics, Iowa State University, Ames.
E. G. Stoneberg.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 5 p.

Descriptors: *Economics, *Confinement pens, *Waste disposal, *Hogs, *Cattle, Costs.
Identifiers: *Swine, *Beef, Environmental standards.

Some of the critical factors which influence the selection of types of confinement and waste systems are presented. The use of confinement systems in beef or swine production substantially increases the capital investment within the enterprise. Because of the high capital requirements of confinement systems, consideration must be given to the potential advantages and disadvantages of this investment and to some of the characteristics of the investment. Although there are wide variations in the investment per animal unit capacity in confinement systems, observation indicates that the average investment per head of annual capacity in a cattle confinement system is normally in the range of $75 to $150. This does not normally include feed storage or processing facilities and may not include feed distribution equipment. The annual ownership costs of a confinement facility will probably fall in the range of 13 to 20 percent of the original cost. Any type of confinement system for pork or beef production requires some provision for animal waste disposal. Environmental standards for disposal of animal wastes may change the structure of the swine and beef industries if these standards are very severe. (Cartmell-East Central).

## 1728-A1, B1, F1, F2

### LEGAL ASPECTS OF LIVESTOCK PRODUCTION AND WASTE MANAGEMENT

Professor of Economics, Iowa State University, Ames.
N. E. Harl.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 11 p.

Descriptors: *Legal aspects, *Livestock, *Farm wastes, *Management, Economics, Costs, Ethics, Negligence, Trespass.
Identifiers: *Production, *Pollution, Nuisance laws, Registration.

Pollution is an economic problem. Three basic approaches are possible to shift the external costs back onto the pollutor. Develop an ethic of environment preservation; create appropriate economic incentives or disincentives to achieve a desired behavior pattern; or impose legal regulations or legal sanctions to circumscribe undesirable behavior patterns. The idea of an environmental ethic is unlikely to be sufficiently effective to improve environmental quality at an acceptable pace. Most ethical standards relied upon by society have come to be backed by the force of law. The concept of taxes or charges on those polluting to (1), encourage substitute production methods that are less harmful to the environment, (2) increase the cost to consumers of products having an adverse effect upon the environment with the result that consumers tend to consume more of the less harmful products, and (3) generate revenues to fund public efforts to improve environmental quality [illegible]lds considerable economic appeal, although relatively little use has been made of this approach in the past. It has become abundantly clear that the rights inherent in land ownership do not sanction or protect activities contributing to environmental pollution. Livestock producers must recognize that fact or face serious legal difficulty either through private litigation, public response to violation of environmental quality standards, or both. (Cartmell-East Central).

## 1729-B1, F1, F2, F4

### EPA'S ROLE IN THE ANIMAL WASTE PROBLEM: PANEL DISCUSSION

Rural Environmental Assistance Program Specialist, Agricultural Stabilization and Conservation Service, United States Department of Agriculture.
H. Andrew.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 6 p.

Descriptors: *Farm wastes, *Farms, *Costs, *Federal government, Pollution abatement, Iowa.
Identifiers: *Environmental Protection Agency, *Animal wastes, *Federal programs.

Agricultural Stabilization and Conservation Service, an agency of the United States Department of Agriculture, administers several programs. Included are loans to farmers on corn, soybeans, and other farm produced commodities; loans for storage facilities; the feed grain and wheat programs which involve direct payments to farmers; a commodity storage program; and, the Rural Environmental Assistance Program (REAP). All of these programs are administered at the county level by a local office staff headed by a three man committee of farmers elected by community committeemen who were elected by their neighbors. These county committees oversee the handling of millions of dollars of government funds each year. They make yield adjustments. They are also charged with the onerous job of deciding who to approve for REAP assistance. Under REAP the Federal Government shares the cost with farmers for doing certain approved conservation and pollution abatement work including animal waste management practices. A brief history of conservation work done on farms is given. (Cartmell-East Central).

## 1730-A2,B2,B4,D3,F1,F2

### SOIL CONSERVATION SERVICE PROGRAM IN ANIMAL WASTE MANAGEMENT

State Conservation Engineer, Soil Conservation Service, Des Moines, Iowa.
D. T. Bondurant.
Animal Waste Management Conference, Iowa State University, Ames, October 13-15, 1971, 6 p.

Descriptors: *Soil conservation, *Farm wastes, *Lagoons, *Anaerobic conditions, *Runoff, Storage tanks.
Identifiers: *Soil Conservation Service, *Animal wastes.

The feedlot registration program in Iowa went into effect on July 1, 1969, and in September, 1969, rules were adopted regulating feedlot runoff from cattle operations. The Soil Conservation Service believed that it could help with this program and, after consulting with the staff of the Iowa Water Pollution Control Commission, formulated a policy regarding activities in this work. Since then standards and specifications have been established for runoff control, anaerobic lagoons and waste storage tanks. Any operatoar who feels that he has a potential pollution problem, even if his operation does not require registration, may be assisted, provided that he secures the approval of the plans developed for his runoff control facilities from the Iowa Pollution Control Commission. The policy of the Service in giving assistance on manure storage tanks is to furnish one of the available standard plans if it can be used directly or can be safely adapted. The Service will not design concrete storage tanks for individual installations. (Cartmell-East Central).

## 1731-A6, D2, D3, E2, F1

### MANURE DEODORANTS . . . HOW WELL DO THEY WORK?

Hog editor.
R. Wilmore.
Farm Journal, Vol. 96, p. 22, 38, J[illegible]e, 1972. 1 fig.

Descriptors: *Odor, *Farm wastes, *Livestock, *Costs, Lagoons.
Identifiers: *Manure, *Odor control, *Deodorants, Soil injection, Land disposal.

Dozens of products are now available which promise to control manure odors. The most comprehensive research has been run by Cornell University. A panel compared odors from treated samples with those from raw manure. Only three things are sure: no product eliminates all odors; some are more effective than others; some don't work at all. The problem of using products to control odor is the cost. The products are felt to be too expensive for what good they do. (Cameron-East Central).

## 1732-B1

### PHOTOGRAPHIC STUDIES OF THE DUNGING BEHAVIOR OF PIGS IN CONFINEMENT

M. S. Thesis, Agricultural Engineering Department, Iowa State University, Ames, Iowa, 1971, 129 p. 31 fig, 38 tab, 23 ref.
J. P. Hultgren.

Descriptors: *Hogs, *Confinement pens, *Farm wastes, *Animal behavior, Economics, Temperature, Light, Design, Water pollution.
Identifiers: *Behavior patterns, Time lapse photography. Cleanliness, Air velocity.

The defecation behavior and feces placement of growing pigs was analyzed. Time lapse photography was used to study three groups of pigs subject to changes in three different environmental stimuli (air temperature, light levels, and air velocity placement). A summary of the results indicated that the pigs spent an average of 81.1% of the day sleeping, 7.6% standing, 10% eating, 0.9% drinking, and 0.4% defecating. Results indicated that the pigs establish quite logical activity patterns. It was also found that pigs defecate from 8-12 times per day. Other studies were concerned with the initial establishment of dunging areas in the pen and the effect of pen and pig cleanliness was found to be heavily dependent on area of pen per pig and area of pen slotted. Evidence was presented that time lapse photography is a useful technique in studying behavior and activity patterns. No matter what technique is used, however, swine defecation remains a very complex and perplexing behavior. (Russell-East Central).

## 1733-A1, A4, A11, A12, B1, E3, F1, F2

### THE ECONOMICS OF THE CATTLE FEEDING INDUSTRY IN ARIZONA

Department of Agricultural Economics, Arizona University, Tuscon.
E. L. Menzie, W. J. Hanekemp, and G. W. Phillips.
Arizona Agricultural Experiment Station, Tucson, Technical Bulletin 207. October, 1973, 82 p. 36 fig, 57 tab, 35 ref.

Descriptors: *Feed lots, *Farm wastes, *Cattle, *Zoning, *Cost analysis, *Arizona, Marketing, Legal aspects, Water pollution sources, Environmental effects, Economics.

Major objectives were to determine changes in the growth and structure of the cattle feeding industry, costs of operation, costs of custom feeding, production problems affecting the competitive nature of the industry, and to analyze the nature of growth and development in beef markets. Data are based on 1972 information, and projections have been made to 1982. Considerable attention is paid to the Arizona feed situation, supply of feeder cattle for Arizona, controls affecting livestock feeding; sources, methods, and costs of finance for feedlots and feeding, marketing of fat cattle and beef, and an assesment of Arizona's competitive position in beef production and marketing, along with the role of changing technology in the industry. The section on controls includes a review of health and sanitation problems of Arizona feedlots, the control of feed supplements, and environmental issues. A particular case involving a suit brought by a land developer against a cattle feeding operation with a non-conforming prior usage right is described; the developer was required to pay for costs involved in the relocation of the feedlot. Consideration of the effect of feedlot wastes on water quality has given rise to a number of research investigations relating to recycling, conversion to other products, confinement feeding, etc., all of which should be accelerated because of the rising demand for beef at the same time that feedlot controls are creating limitations on this type of beef production. (Paylore-Arizona).

## 1734-A11, C2, E3

### DIGESTIBILITY AND FEEDING VALUE OF WASTELAGE

L. S. Bandel.
M. S. Thesis, Department of Animal Science, Auburn University, 1969, 67 p. 3 fig, 18 tab, 52 ref.

Descriptors: *Feeds, *Digestion, *Waste disposal, *Recycling, Nutrient requirements, Farm wastes, Cattle, Lambs, Hogs, Poultry, Nitrogen, Protein, Carbohydrates, Chemical analysis, Feed lots, Performance, Diets.
Identifiers: *Wastelage, *Digestibility, Nylon bag test, Dry matter, Corn.

For the purpose of studying the feeding value of wastelage, six yearling steers were allotted to five groups of twelve animals each and were fed a variety of ratios of wastelage and ground or whole shelled corn. The first group was fed a normal steer fattening ration, while groups two through five were fed ratios of 1:4, 2:3, 2:3, and 3:2 of wastelage to corn. After a fourteen day adjustment period, the five groups of cattle were fed for 110 days. Results indicated that feeding wastelage and ground corn improved feed efficiency by eight percent. Also increasing the fiber content by increasing the amount of wastelage in the ration decreased digestibility. A nitrogen-balance test study was conducted with lambs, and it was found that the addition of wastelage to a ration usually lowered the crude protein and dry matter intake. Adding corn to wastelage usually improved the dry matter intake, crude protein digestibility, and the nitrogen retention. (Russell-East Central).

## 1735-A6, B1

### ODORS PRODUCED BY SWINE IN CONFINEMENT HOUSING

W. C. Hammond.
MS Thesis, Agricultural Engineering Department, University of Illinois, 1964, 83 p. 24 fig, 21 tab, 26 ref.

Descriptors: *Odor, *Hogs, Confinement pens, *Farm wastes, Analysis, Ammonia, Ventilation, Spectroscopy, Chromatography, Gases, Humidity, Temperature.
Identifiers: *Confinement housing, Concrete floor.

This project was undertaken to find out what makes confinement swine buildings have objectionable odor, where the odor originates, and some methods which reduce or destroy the odor. A comparison was made between buildings with solid concrete floors with a center gutter and totally slotted concrete floors with ponded waste under the whole floor area. The comparison of odors was made by an odor panel. Odor samples were collected and dilution thresholds ranged from 0.0 to 6.0. The 6.0 meant that no panel member could detect the odor present in the swine building when 6 parts of clean air were mixed with one part odor. The results of ammonia analyzed from the floor lead one to believe that the floor liberated a large part of the odor. This is a result of acid fermentation within the concrete. Statistical analysis fails to indicate any correlation between odor produced by swine in confinement buildings with respect to pig weight or floor temperature. The indication is that the swine odor is defined in terms of other variables such as humidity, dry bulb temperature, ventilation, or bacteria in the swine's atmosphere, or some other variable. (Russell-East Central).

## 1736-A6, D3, F3

### ODOR CONTROL AND DEGRADATION OF SWINE MANURE WITH MINIMUM AERATION

Department of Agricultural Engineering, Illinois University, Urbana-Champaign.
J. C. Converse.
PhD Thesis, Department of Agricultural Engineering, University of Illinois, Urbana-Champaign, 1970, 198 p. 58 fig, 48 tab, 36 ref.

Descriptors: *Odor, *Control, *Degradation (Decomposition), *Farm wastes, *Hogs, Confinement pens, Aeration, Gases, Anaerobic conditions, Ammonia, Hydrogen sulfide, Analysis, Chemical oxygen demand, Hydrogen ion concentration, Waste storage, Waste treatment.
Identifiers: *Swine, *Manure, Foaming.

Many problems are facing today's confinement swine production. One major problem is odor. Odor not only brings public indignance, it also is potentially harmful to swine enclosed in a confinement pen because of the gases which cause it. In total confinement, manure is often stored in pits for long periods of time. If good anaerobic decomposition occurs carbon dioxide and methane, which are odorless, will be given off. However, the condition which usually exists in an undisturbed pit is one in between good aerobic and anaerobic decompisition. As a result, $CO_2$, $H_2S$, $NH_3$, and $CH_4$ are emitted. Also many organic intermediates are found. Some of the intermediates are very odorous. Most researchers have concluded that an excessive amount of air is necessary for optimum manure degradation, but this results in high costs to maintain an excessive amount of air. However, the results of this study indicate that it is possible to aerate liquid hog manure with a small amount of air and still maintain relatively odorless conditions. What is necessary now is field applications to determine the feasibility of operating a system with minimum aeration. (Russell-East Central).

## 1737-A11, B1

### SLOTTED FLOORS FOR HOGS — PROGRESS AND TRENDS

Agricultural Experiment Station, Oregon State University, Corvallis.
A. J. Muehling.
Presented at 1971 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 7-10, Paper No. 71-930, p. 1-17. 26 fig, 1 tab, 13 ref.

Descriptors: *Hogs, *Farm wastes, *Design, *Construction, Materials.
Identifiers: *Slotted floors, Wood slats, Concrete slats, Metal slats.

Use of self-cleaning slotted floors for hog raising has made great changes in the industry. Labor costs for removal of manure have dropped, while sanitation and hog health have risen markedly. Three types of slats are used for flooring. Wood, usually hardwood laid green, is the cheapest, but does not last very long and warps easily. Because of the warping, it is difficult to maintain equal distance between the slats, a real problem when the pens are used for baby pigs. Concrete slats are very effective when they are well made, that is, when the reinforcing bar is laid on the bottom and when the tops are smoothed to eliminate abrasions on the animals' knees. The problem with concrete slats has been that commercially produced ones, of good quality, are hard to obtain, and transport costs are very high. The alternative is to cast them on the site, but not every farmer has produced slats of adequate quality when casting them himself. Metal slats are more expensive and may wear quickly if exposed to manure; this depends on the metal and on the amount of moisture present. The present trend is to all-slotted floors, rather than the partially slotted ones used a few years ago. They can be used, with adaptations, for all phases of hog-raising — farrowing, finishing, and sow gestation. Many sows will not breed on slats, however; perhaps it is too difficult to get a foothold. (Solid Waste Information Retrieval System).

## 1738-B2, B4, C2, F1

### STORAGE LAGOON VERSUS UNDERFLOOR TANK FOR DAIRY CATTLE MANURE

Agricultural Engineering Department
College of Agricultural and Life Sciences
University of Wisconsin
Madison
J. C. Converse, C. O. Cramer, H. J. Larsen, and R. F. Johannes.
Presented at the 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-3028, 13 p. 5 fig, 4 tab, 6 ref.

Descriptors: *Waste storage, *Farm wastes, *Lagoons, *Cattle, *Dairy industry, *Costs, Confinement pens, Liquid wastes, Chemical characteristics.
Identifiers: *Manure, *Slotted floor-underfloor tank, *Manure scrape-storage lagoon

The following liquid manure handling systems were compared during a 2½ year study: slotted floor-underfloor tank, manure scraper-storage lagoon for insulated housing, and manure scraper storage lagoon for uninsulated housing.Each system handled 20 cows in free-stall housing. As was hoped the automatic manure scraper-storage lagoon provided a feasible alternative to storage of manure in tanks under slotted floors. For the size herds studied, investment costs for the manure scrape-storage lagoon system were approximately $200 cheaper per cow than for the slotted floor-underfloor tank. Annual costs for the manure handling system were approximately $20 cheaper per cow for the manure scrape insulated barn than for the other two systems. (Cartmell-East Central).

## 1739-A2, B2, C2, E2

### CATTLE FEEDLOT POLLUTION STUDY

Department of Agronomy
Texas Tech University
Lubbock
E. A. Coleman, W. Grub, R. C. Albin, G. F. Meenaghan, and D. M. Wells.
Interim Report No. 2 to Texas Water Quality Board, Texas Tech University Water Resources Center, Lubbock, Texas, April, 1971, WRC-71-2, 12 p. 8 tab.

Descriptors: *Waste treatment, *Waste disposal, *Cattle, *Feedlots, *Irrigation, *Runoff, Application rates, Soil contamination, *Farm wastes, Salts, Cotton, Grain sorghum, Soybeans, Bermudagrass.

Germination studies, test plot studies, and field studies were made to determine beneficial or non-harmful rates at which runoff from cattle feedlots can be applied to growing crops. Results indicate that such runoff must be applied with caution to most crops, as it is very detrimental to the germination of most field crops in the High Plains area of West Texas and is also detrimental to seedlings in the same area. However, relatively low application rates are beneficial to mature crops at least on a short term basis. The buildup of soluable salts in the upper 30 inches of the soil profile indicates that land disposal may not be the ultimate solution to runoff disposal. (Wetherill-East Central)

## 1740-A2, B2, B3, C2, E2

### RUNOFF CONTROL SYSTEMS FOR PAVED DAIRY CATTLE YARDS

Agricultural Engineering Department
College of Agricultural and Life Sciences
Wisconsin University, Madison
C. O. Cramer, T. J. Brevik, G. H. Tenpas and D. A. Schlough
Presented at 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4016, 22 p. 11 fig. 6 tab.

Descriptors: *Runoff control, *Dairy industry, Precipitation (atmospheric), Effluent, Chemical properties.
Identifiers: *Paved cattle yards, *Solid separation, *Detention pond.

Runoff control systems were developed and monitored for two dairy cattle yards. One system was for 200 milk cows plus heifers in cold free stall barns with yard feeding. The other was for 32 cows in a stanchion barn with paved exercise yard for heifers and dairy beef in loose housing with yard feeding. Both systems used the same principles of solids separation, liquid storage and land application of wastes. At the first farm 49 and 45 percent of the precipitation falling on the paved and unpaved yards and contributing roof areas was collected as runoff for the two years of study. The corresponding volumes of effluent removed from the detention pond were 2.7 and 1.7 million gallons. At the second farm, the percentage of precipitation collected was 84, 67, and 71 percent for the three periods of study. The volume of effluent removed was 0.6 and 0.5 million gallons for the first two full years. Characteristics of the detention pond effluents varied widely. Rock-filled porous dams were unsatisfactory for primary liquids-solids separation. Expanded metal screens were better. Detention ponds in both systems had insufficient capacity to allow effluent to be applied only when soil conditions were favorable. Considerable labor and management were required for successful operation of the runoff control systems. (Merryman-East Central)

## 1741-A2, B2, B4, E2, F1

### CHANGES WE'VE MADE IN MANURE HANDLING

Hoard's Dairyman, Vol. 118, No. 3, p. 152-153, 204-205, February 10, 1973. 4 fig.

Descriptors: *Farm wastes, *Waste storage, *Waste disposal, *Runoff, *Costs, Cattle, Dairy industry, Equipment.
Identifiers: *Manure.

Four dairymen with herds ranging from 30 to 230 cows discuss changes in their waste handling methods. All have switched to storage pits and then to land disposal at costs ranging from $850 to $6,000. Each farmer explains his variation of waste storage with respect to less frequent handling and controlling runoff. Costs, disposal practices and manure pits of each system are discussed. (Frantz-East Central).

## 1742-A2, A6, B2, D3, E2

### A COMPARISON OF AN AERATED LAGOON AND IRRIGATION SYSTEM WITH A CONVENTIONAL SYSTEM FOR DAIRY WASTE DISPOSAL

M. P. Douglas
MS Thesis, Department of Agricultural Engineering, Purdue University, 1971, 81 p. 24 fig, 23 tab, 25 ref.

Descriptors: *Lagoons, *Aerobic conditions, *Irrigation, *Waste disposal, *Dairy industry, *Farm wastes, Waste treatment, Waste storage, Costs, Odor, Runoff, Labor, Equipment, Construction, Indiana.

A comparison was made between the conventional waste handling system and an aerated lagoon and irrigation system at Purdue Dairy Center. The cost of the conventional system was $32.90 per cow per annum, but was largely dependent upon weather conditions, It showed high variable and labor costs. The newer method was a mechanically aerated deep lagoon, whose level was controlled by irrigation on adjacent land. Cost per cow was $48 per year, but much of the extra cost was reclaimed in greater flexibility of the farm operation and in labor utilization. Nitrate pollution in runoff into water was zero. The system was odorless while it was economically comparable to other systems. The influence of weather conditions and usage of labor were minimized. The new method was acceptable from the odor and pollution control aspect and would be acceptable to commercial enterprises. (Frantz-East Central).

## 1743-B1, B4, D3, E2

### STRUCTURAL ANALYSIS OF FLOOR GRIDS FOR CONFINEMENT CATTLE FEEDING SYSTEMS

North Dakota State University
Fargo
Presented at 1966 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 6-9, 1966, Paper No. 66-924, 21 p. 9 fig, 4 tab, 21 ref.

Descriptors: *Confinement pens, *Cattle, *Livestock, *Farm wastes, *Waste storage, *Waste treatment, *Waste disposal, *Design.
Identifiers: *Land disposal, *Storage pits, *Floor grids.

Perforated floor systems are being used in barns as devices for collecting waste material from livestock. Movement of the livestock on the floor forces the waste material through the perforations into storage pits below the floor. Livestock waste collected in this way can be spread on fields as fertilizer or can be stabilized by the action of microorganisms. These methods of livestock waste disposal are proving to be more efficient than conventional solid waste handling systems have been. Structural design, parameters, and equations are given. (Wetherill-East Central).

## 1744-A1, B2, B4, D3, F1

### FIELD PERFORMANCE OF SELECTED BEEF FEEDLOT WASTE HANDLING SYSTEMS

Extension Agricultural Engineer
University of Illinois
Urbana-Champaign
D. H. Vanderholm, J. C. Lorimor, and S. W. Melvin.
Presented at 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4015, 9 p. 5 fig, 2 tab, 2 ref.

Descriptors: *Cattle, *Farm wastes, *Management, *Feed lots, Monitoring, Waste storage, *Waste disposal, *Corn Belt, Oxidation lagoons.
Identifiers: *Pollution control.

Four feedlots were selected as research and demonstration sites to study waste management alternatives in the Corn Belt. Two were unsurfaced open lots utilizing holding ponds. The other two were cold confinement slotted-floor barns, one with a conventional deep pit manure storage and one with an under-floor oxidation ditch system. No attempt was made to rate the systems relative to one another, but data and observations were intended to provide a basis for evaluating the systems individually and collectively. All of the systems described in this paper were properly managed. (Cartmell-East Central).

## 1745-A8, B1, E2

### GUIDELINES FOR APPLYING BEEF FEEDLOT MANURE TO FIELDS

Cooperative Extension Service
Kansas State University
Manhattan
Kansas State University
A publication of the Cooperative Extension Service, Kansas State University, Manhattan, 1974, 11 p. 9 fig, 4 tab, 7 ref.

Descriptors: *Feed lots, *Farm wastes, *Waste disposal, *Cattle, Nutrients, Nitrogen, Salinity.
Identifiers: Land application, *Guidelines.

This publication gives guidelines for applying solid beef-cattle, feedlot manure to agricultural land. Guidelines on solid manure given here can be used to determine (1) the amount of manure needed to supply enough nitrogen for crops, or (2) maximum rates when soil is used as a disposal medium for feedlot manure. These steps are suggested when applying beef cattle feedlot manure to soil: 1. Have the manure and irrigation water analyzed. 2. Determine the texture of the soil receiving the manure. 3. If the manure is to be a source of nitrogen, determine application rates for each year. 4. If the manure is applied to irrigated land, determine each maximum annual application rate. 5. If the manure is applied to non-irrigated land, determine the maximum annual application rate. 6. Have annual salt-alkali and soil fertility tests performed on the soil to check for salt buildup and nitrate accumulation. (Cartmell-East Central).

## 1746-D2, E3, F1

### CATTLE MANURE TO PIPELINE GAS — A PROCESS STUDY

Chemical Research Engineer
Pittsburgh Energy Research Center
Bureau of Mines
Pittsburgh, Pennsylvania
H. F. Feldman, K. Kiang, Chin Yung Wen, and P. M. Yavorsky.
American Society of Mechanical Engineers Publication, 73-Pet-21, 1973, 7 p. 1 fig, 3 tab, 6 ref.

Descriptors: *Farm wastes, *Cattle, *Gases, *Fuels, Pipelines, Costs, Waste treatment, Waste disposal.
Identifiers: Manure, Hydrogasification

A process study based on experimental manure hydrogasification data demonstrates the feasibility of converting manure to pipeline gas on a large scale. For reasonably large plants, the pipeline gas from such a conversion process is estimated to be considerably cheaper than gas from any other source, except natural gas currently being produced in the lower 48 states. The primary reason for these favorable economics is that the manure is assumed to be free. Because of the important effect of plant size on gas price, more detailed estimates will be made of smaller plants to determine the minimum feasibile plant size and thereby determine the areas of the country where application of this technology would be economically feasible. (Cartmell-East Central).

## 1747-A11, B1, E3

### FLY PUPAE AS A DIETARY INGREDIENT FOR STARTING CHICKS

Department of Animal Sciences
Colorado State University
Fort Collins
J. S. Teotia and B. F. Miller
Poultry Science, Vol, 52, No. 5, p. 1830-1835, September, 1973. 6 tab., 6 ref.

Descriptors: *Diets, *Poultry, *Proteins, *Performance, Feeds.
Identifiers: *Fly pupae, Catabolized manure.

Since fly pupae have been demonstrated to have high quality protein, 2 feeding trials were conducted to determine their feeding value for broiler chicks. In the first trial, White Plymouth Rock broiler chicks were fed a standard chick starter ration and a diet containing 28% dried fly pupae as the only protein source. Chicks fed pupae as the only protein supplement showed no significant difference in weight gain when compared with chicks fed the control diet during the seven weeks of experimental period. In the second trial, fly pupae replaced fish meal and meat and bone meal. Catabolized manure was used from five to ten percent to replace milo in the ration. New Hampshire and Indian River broiler chicks were fed these rations from one day through four weeks of age. No significant differences in body weight or feed conversion were found among the different treatments. (Cartmell-East Central).

### 1748-B2,C2,C3,D2,D3,E3,F1
## FLOCCULATING AGENTS FOR RECOVERING CATTLE WASTE SOLIDS

Agricultural Research Service
U. S. Department of Agriculture
Northern Regional Laboratory
Peoria, Illinois
R. W. Jones, J. H. Sloneker, and G. Frankl.
67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4037, 7 p. 7 tab, 9 ref.

Descriptors: *Flocculations, *Cattle, *Farm wastes, *Solid wastes, Proteins, Oxidation lagoons, Microorganisms, Settling, Nitrogen, Polymers.
Identifiers: *Flocculating agents, *Solids recovery, Manure.

A potential feed protein can be recovered from the solids of a cattle oxidation ditch. In some ditches, a viscous biopolymer interferes with settling and collecting suspended solids. A flocculating agent was found that increases recovery of suspended matter from 67 to 89 percent and of nitrogen from 45 to 82 percent. Expenditure of $1.00 for chemicals increases the quantity of feed fraction by an equivalent amount. A flocculating agent also raises the yield of feed from whole manure. Eight flocculating agents are listed. (Cartmell-East Central).

### 1749-B2, C1, C2, F2
## A CHARACTERIZATION OF THE EFFLUENT FROM COMMERCIAL CATFISH PONDS

Agricultural Enigreering Department
Purdue University
Lafayette, Indiana
D. B. Beasley and J. B. Allen
67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-5004, 28 p. 16 fig, 5 tab, 9 ref.

Descriptors: *Effluent, *Fish farming, *Farm wastes, Water sampling, Ponds, Biochemical oxygen demand, Nutrients.
Identifiers: *Commercial catfish ponds, Total solids.

This investigation was carried out to obtain a meaningful chemical and biochemical characterization of the effluent from commercial catfish ponds. The water samples were taken from commercial catfish ponds in both the Mississippi and Arkansas Delta areas. The ponds ranged in size from 10 to 40 acres and the stocking rates included 1800, 2000, and 3000 fish per acre. All of the ponds were sampled on the surface, and one pond at each stocking rate was also sampled at the bottom. This data was arranged in order to compare both the differences in stocking rates and the difference in sampling depths. The water quality in the ponds monitored usually met or exceeded standards set forth for recreational waters by the Mississippi Air and Water Pollution Control Commission. In a majority of cases, the values of most of the parameters obtained from samples taken from the bottom of these ponds was slightly nigher than corresponding values obtained from samples taken at the surface. Also, the ponds stocked at higher rates usually had slightly higher values of BOD, nutrients, and total solids. (Cartmell-East Central).

### 1750-A9, A10, D2
## COMPARATIVE EFFECTIVENESS AND PERSISTANCE OF CERTAIN INSECTICIDES IN POULTRY DROPPINGS AGAINST LARVAE OF THE LITTLE HOUSE FLY

Department of Entomology and Plant Pathology
College of Agriculture
University of Massachusetts
J. W. Eversole, J. H. Lilly, and F. R. Shaw.
Journal of Economic Entomology, Vol. 58, No. 4, p. 704-709, August, 1965. 3 tab., 15 ref.

Descriptors: *Insecticides, *Poultry, *Farm wastes, *Waste treatment, *Larvae, *Toxicity, Massachusetts, Cultures.
Identifiers: *Little house fly, *fannia canicularis L.

Selected insecticides were added to poultry droppings and then compared. Each insecticide was added at five levels ranging from 0.25 mg/kg. of droppings to 4.0 mg./kg. Little house fly (fannia canicularis L.) larvae were added to the cultures at both 0 hr. and 48 hr. and placed in an incubator for seven days, Dimethoate was substantially more effective than the other insecticides. It produced substantial larval mortalities at the 0.25 mg./kg. level and remained effective after 48 hr. at the 1.0 mg/kg. level. Diazinon and coumaphos remained effective after 48 hr. at the 1.0 mg/kg. level. Other insecticides were less effective. (Frantz-East Central).

### 1751-A8, C2, E2
## CHEMICAL CHANGES IN SOLIDS USED FOR BEEF MANURE DISPOSAL

Department of Agricultural Engineering
Texas A & M University
College Station
D. L. Reddell, R. C. Egg, and V. L. Smith.
67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4060, 28 p. 13 fig, 5 tab, 22 ref.

Descriptors: *Farm wastes, *Cattle, *Waste disposal, *Sampling, *Soils, Rates of application, Nutrients, Nitrogen, Nitrates, Ammonia, Sodium, Chloride, Potassium, Texas.
Identifiers: Land disposal, *Pullman clay loam soil, Crop yields, Pollution.

To study the effects of large manure applications on land, research was started by the Texas Agricultural Experiment Station and the Texas Cattle Feeders Association. Manure was applied to Pullman loam soil in the High Plains of Texas at rates of 0, 224, 336, 672, 1345, and 2017 mtons/ha and deep plowed into the soil. A second manure application was made on the 0, 224, 336, and 672 mton/ha plots and a third application on the 0, 224, and 336 mton/ha plots. Soil samples were collected 17 months after the initial application. The sodium, chloride, potassium and conductivity of the samples increased greatly for the large manure application of 2017 mton/ha. Total nitrogen was greatly increased in the 0 to 30 cm soil layer. Crop yields for corn and grain sorghum were considered good for the 224, 336, and 672 mton/ha plots, but a 50 percent reduction. Crop yields occurred on the 1345 and 2017 mton/ha plots. The following conclusions were made: 1. Increased soil salinity problems caused by repeated large manure applications (1345 and 2017 mton/ha) will greatly decrease crop growth capabilities, 2. Annual manure applications of 224 to 336 mton/ha can probably be made for several years without decreasing crop yields substantially or causing serious environmental problems. (Cartmell-East Central).

### 1752-A6,B1,C2,D3,E2,F1
## ANIMAL WASTES AERATION IMPROVES BIOREDUCTION BY FLY LARVAE

Entomology Research Division, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.
N. O. Morgan and H. J. Eby.
Presented at Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-453, 9 p. 1 ref.

Descriptors: *Farm wastes, *Aeration, *Larvae, Poultry, Climate, Odor, Profit, Proteins, Salts, Ammonium salts, Carbonates.
Identifiers: Biological reduction, *Fly larvae, Manure.

An effective process for aerobic decomposition of livestock wastes and the production of useful byproducts was demonstrated by Calvert et. al. (1970). House fly larvae were selected as the bioreducing agent, Aeration of manure was the key condition to successful fly larval reduction of large volumes of manure in a minimum of space. When given the advantage of a controlled climate within a manure reduction cell, house fly larvae can convert 100 pounds of manure to 2.5-3.0 pounds of good protein feed supplement and 50-50 pounds of semidry, practically odorless soil conditioner. Although a dollar and cents value has not been calculated to include all of the products of the controlled wastes reduction program, the total recycling of livestock wastes could have quite a bearing on the stockman's economy. (Cemefon-East Central).

### 1753-A2,A3,A4,A12,C3,D3
## BUFFALO LAKE RECREATIONAL WATER QUALITY: A STUDY IN BACTERIOLOGICAL DATA INTERPRETATION

Chief Bacteriologist, Water Supply Research Laboratory, National Environmental Research Center, United States Environmental Protection Agency, Cincinnati, Ohio.
E. E. Geldreich.
Water Research, Vol. 6, p. 913-924, 1972. 5 fig, 43 ref.
*Water quality, *Bacteria, *Water pollution, *Sewage effluents, *Feed lots, *Farm wastes, Coliforms, Texas.
*Buffalo Lake.

Descriptors: *Water quality, *Bacteria, *Water Pollution, *Sewage effluents, *Feed lots, *Farm wastes, Coliforms, Texas.
Identifiers: *Buffalo Lake,

Bacteriological measurements of fecal pollution, fecal coliform correlations with salmonella occurrence, and fecal streptococci significance in water are discussed. Buffalo Lake, some 30 miles southwest of Amarillo, Texas, is part of a national wildlife refuge managed by the U.S. Fish and Wildlife Service which permits various designated recreational uses including fishing, boating, water-skiing, swimming and camping. The major source of water entering Buffalo Lake is derived from Tierra Blanca Creek and its largest intermittent tributary, Frio Draw. The most significant pollution contribution during the dry weather occurs at a location where the sewage of Hereford, Texas, is processed through an Imhoff Tank into a trickling filter, and then passed into a series of 6 lagoons for further treatment prior to being discharged into the creek. Other pollution occurs from pasture and farmland drainage and from cattle feedlot runoff. Although this survey failed to demonstrate a significant public health hazard to recreational users of Buffalo Lake during the May to July, 1968, field study, a combination of factors necessary to produce unsatisfactory bathing water quality will continue to be a serious threat that could erupt in the future. Any sudden increase in fecal contamination of the bathing water will also introduce a concurrent rise in the probability that enterovirus, Salmonella, Leptospira, or other pathogenic strains will occur. Control measures are recommended. (Cartmell-East Central).

## 1754-A2, B2, B3, C2, E2,
### BIOLOGICAL TREATMENT OF FEEDLOT RUNOFF FOLLOWING SETTLING
Department of Civil Engineering
University of Nebraska
Lincoln
T. J. McGhee
Presented at the 66th Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-413, 19 p. 12 fig, 1 tab, 13 ref.

Descriptors: *Feed lots, *Farm wastes, *Runoff, *Waste treatment, *Biological treatment, Activated sludge, Design, Costs, Chemical oxygen demand, Effluent.
Identifiers: Settling.

An activated sludge system designed for the treatment of settled feedlot runoff has been studied both in the laboratory and in the field. Initial studies utilizing the gravity solids return system demonstrated that reductions in COD of approximately 60% were attainable at liquid retention times of 4 days or more. From the data obtained in the laboratory study, it was concluded that the field system should be designed to operate at a liquid retention time of two days or more and at an organic loading rate of less than 1.0 lb. COD per lb. MLSS per day. Calculations based upon the average annual runoff from the lots and of the annual rates of precipitation and evaporation in eastern Nebraska indicated that the required volume would be 890 gallons assuming that operation would be possible for 180 days per year. The cost of effectively treating settled feedlot runoff with an aerobic biological system has been estimated to be $0.65 per head for the climatic conditions of eastern Nebraska. This cost is dependent upon animal density, climate, and the balance between holding pond and treatment unit size. (Cartmell-East Central).

## 1755-A8, C2, E2
### AUTOMATED TOTAL NITROGEN ANALYSIS OF SOIL AND PLANT SAMPLES
Soil Scientist
United States Department of Agriculture
G. E. Schuman, M. A. Stanley, and D. Knudsen.
Soil Science Society of America Proceedings, Vol. 37, No. 3, p. 480-481, May-June, 1973. 2 fig, 2 tab, 6 ref.

Descriptors: *Sampling, *Soils, *Nitrogen, Digestion, Automation, Farm wastes, Fertilizers.
Identifiers: *Plants, Soil research.

Pollution-oriented research, dealing with commercial fertilization and animal wastes, necessitates analysis of large numbers of samples to characterize the problem. A digestion-analysis system that can digest large numbers of samples and analyze these digests at the rate of 30 samples per hour, is described. The tecator digestor and Technicon Auto Analyzer, has proved to be as reliable as the standard micro-Kjeldahl procedure and the system is compact and involves fewer steps for analytical error. (Cartmell-East Central).

## 1756-A2, B2, B4, C2, E2
### ANALYSIS OF RUNOFF FROM SOUTHERN GREAT PLAINS FEEDLOTS
Agricultural Research Service
United States Department of Agriculture
Bushland, Texas
R. N. Clark, A. D. Schneider, and B. A. Stewart.
Presented at 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, June 23-26, 1974, Paper No. 74-4017, 11 p. 6 fig, 7 ref.

Descriptors: *Runoff, *Analysis, *Feed lots, *Rainfall-runoff relationships, *Farm wastes, Cattle, Plants, Irrigation, Salts, Waste dilution, Storm runoff, Great Plains.
Identifiers: Catchment basins.

Runoff amounts and chemical quality have been measured from a Southern Great Plains cattle feedlot. The rainfall-runoff relationship for runoff-producing storms was linear with about one-third of the rainfall in excess of 0.40 inch ending up as runoff. Two types of runoff catchment basins were used which met the zero discharge requirements of water control agencies. One was a natural-occurring, wet-weather lake called a playa. The other type was a manmade holding pond generally excavated downslope from the feedlot. High evaporation rates and high stocking rates caused the manure pack in the feedlots to contain more salts, thus allowing increased concentrations in runoff. For most holding ponds, a dilution ratio of 5 parts well water to 1 part feedlot runoff would reduce the salinity hazard for irrigation. Runoff caught in playas had enough natural dilution to be used with a minimum salinity hazard. (Cameron-East Central).

## 1757-B2, B4, D3, E2, F1
### AN ANALYSIS OF THE WATER BUDGET AND WASTE TREATMENT AT A MODERN DAIRY
Agricultural and Biological Engineering Department
Mississippi State University
Mississippi State
J. B. Allen, J. F. Beatty, S. P. Crockett, and B. L, Arnold.
Presented at 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4038, 28 p. 15 fig, 3 tab, 7 ref.

Descriptors: *Water, *Budgeting, *Analysis, *Waste treatment, *Farm wastes, *Dairy industry, Lagoons, Irrigation, Mississippi.

The objectives of this study were to investigate the water budget at a modern 130-cow dairy and to investigate the operating efficiency of a combined anaerobic-aerobic lagoon waste treatment system at the dairy. The water usage at a 114-cow dairy utilizing alley and milking parlor flush systems averaged 16, 738 gpd. The overall treatment efficiency of a 2 cell lagoon system receiving the dairy waste averaged 86.5%. The final effluent had an average BOD of 98 mg/1. Excess discharge from the lagoon system had an average BOD of 98 mg/1. Excess discharge from the lagoon system required disposal by irrigation on pastures during summer months. A reservoir with 15 acre-ft. of storage capacity will be required during winter months. (Cartmell-East Central).

## 1758-A3, A6, B2, C1, C2, D3, E2
### DESIGN PARAMETERS FOR ANIMAL WASTE TREATMENT SYSTEMS
Agricultural Waste Management Program
College of Agriculture and Life Sciences,
Cornell University
Ithaca, New York
T. B. S. Prakasam, R. C. Loehr, P. Y. Yang, T. W. Scott, and T. W. Bateman.
Environmental Protection Agency report number EPA-660/2-74-063, July, 1974, 218 p. 82 fig, 35 tab, 60 ref.

Descriptors: *Liquid aeration systems, *Farm wastes, *Oxidation lagoons, *Design, *Waste treatment, Nitrogen transformations, Nitrogen losses, COD removal, Odor control, Land disposal, Rates of application, Corn, Orchard and bromegrass response, Runoff losses.
Identifiers: Animal waste treatment, Design parameters, Plant response to treated and untreated poultry manure.

Laboratory, pilot plant, and full-scale studies evaluated design parameters for liquid aeration systems treating livestock waste. Of the various approaches tested, the mass balance approach is the preferred approach since it yielded results comparable to other approaches and involved fewer assumptions. Equations were developed to predict the COD and suspended solids concentrations in the effluent from the aeration systems. A design example is included for both odor control and stabilization of the waste including minimal aeration as well as nitrification. In laboratory and full-scale livestock waste treatment systems uncontrolled nitrogen losses occurred. Preliminary investigations identified the engineering opportunities for the control of nitrogen in aeration units by either conservation or removal. Acid soils conserved nitrogen in poultry manure. Neutral soils accumulated NO2 at toxic levels. Untreated manure was inferior to treated manure as a N source. Rates over 30 tons damaged corn. Runoff losses of N and P were slight. Orchard grass responded but bromegrass did not respond to poultry manure applications. (Prakasam, Scott — Cornell University).

## 1759-A2, B5, C1, C2, C3
### POLLUTION FROM ANIMAL FEEDLOTS
Department of Agricultural Engineering
Kansas State University
Manhattan
R. I. Lipper.
Kansas Water Resources Research Institute, Manhattan, Project Completion Report, Contribution No. 121, May, 1973, 19 p. 17 fig, 15 tab, 28 ref.

Descriptors: Feedlots, *Water pollution sources, *Farm wastes, *Rainfall simulators, Runoff, Hydrology, Chemical oxygen demand, Biochemical oxygen demand, Nitrogen compounds, Bacteria, Solid wastes, Water pollution control.
Identifiers: *Beef animals, Characterization.

Two test feedlots, each with an area of 0.05 were stocked with beef animals on a finishing ration at a rate of 200 animals per acre (10 steers per test lot). One feedlot was entirely surfaced with concrete, the other only at feedbunk and waterer. Slope was 2 percent. Rainfall was simulated by sprinklers capable of application rates from 0.4 to 2.5 per hour. Runoff was measured and sampled. Runoff rate and volume were compared to application rate and volume. Concentrations of BOD, COD, nitrogen compounds, solids, and bacteria were determined. The effects of certain management practices on runoff characteristics were observed. (Water Resources Scientific Information Center)

## 1760-B2, D3, E3, E4, F5, F6
### HYDRAULIC HANDLING OF POULTRY MANURE INTEGRATED INTO AN ALGAL RECOVERY SYSTEM
California University at Richmond and Berkeley
C. G. Golueke, and W. J. Oswald.
Presented at Proceedings of the 1969 National Poultry Litter and Waste Management Seminar, Salisbury, Maryland, September 29-30, 1969, p. 57-58, 6 fig, 14 ref.

Descriptors: *Poultry, *Farm wastes, *Hydraulics, *Waste treatment, *Algae, Recycling, Settling tanks, Digestion tank, Feeds, Effluent, Aerobic conditions, Anaerobic conditions, Centrifugation.
Identifiers: *Manure, *Algae pond, Loading rates.

Because of increasing pollution regulations and urbanization of rural areas, the problems of disposal of animal wastes are becoming more complex. Disposal by land spreading has in the past been the major means of disposal, but in many areas this method is no longer feasible. New and economically feasible methods of disposal are being developed and adopted. One such method is photosynthetic reclamation, with the incorporation of a manure hydraulic flushing and transport system. At the University of California's Sanitary Engineering Research Laboratory a three-year project is being conducted. Its objectives are to reduce the nuisance qualities of wastes and in the process, researchers are trying to recover algae which would be fed back to the animals. The project also involves the laboratory studies and design and construction of an algae growth pond. Plans for the future call for experiments in which the anaerobic phase will be by-passed. Also the algae which is harvested as a product of the wastes will be fed to ruminants to determine its nutrient potential. (Russell-East Central).

## 1761-A2, B2, B4, C2. D3

### HYDROLOGIC AND WATER QUALITY CHARACTERISTICS OF BEEF FEEDLOT RUNOFF

W. J. Fields
M. S. Thesis, Department of Agricultural Engineering, Kansas State University, Manhattan, May, 1971, 79 p. 12 fig, 10 tab, 50 ref.

Descriptors: *Hydrologic properties, *Water quality, *Feed lots, *Cattle, *Runoff, Farm wastes, Lagoons, Waste storage.

A study was conducted on a commercial cattle feedlot to determine runoff quantity and pollution parameters resulting from natural rainfall, to evaluate methods for predicting runoff quantity, rate, and pollution concentrations, and to develop and evaluate equations for estimating hydrologic and water quality characteristics of runoff from a beef feedlot. Two areas, No. 2 (25 pens covering 27.4 acres) and No. 119 (1 pen, 1.72 acres), were studied for runoff characteristics. Both areas drained into an anaerobic lagoon, Results indicated that mean pollutant concentrations from snowmelt runoff were 2 to 2.5 times greater than concentrations from rainfall runoff. Volatile solids percentages increased with decreasing temperatures. A chemical oxygen demand equation was determined for the runoff. A reliable basis for predicting feed lot runoff volume was developed. An equation for predicting maximum runoff flow rate was also developed. (Frantz-East Central).

## 1762-A8, C2

### INVESTIGATION OF SOME FACTORS INFLUENCING DENITRIFICATION IN A LABORATORY SOIL COLUMN WITH A SURFACE LOADING OF LIVESTOCK WASTES

C. V. Booram, Jr.
M. S. Thesis, Department of Agricultural Engineering, Kansas State University, Manhattan, May, 1971, 75 p. 22 fig, 14 tab, 27 ref.

Descriptors: *Denitrification, *Farm wastes, *Nitrates, Soils, Aerobic conditions, Anaerobic conditions, Equipment, Leaching, Kansas.
Identifiers: *Soil columns, *Surface loading.

Two experiments were conducted to determine factors affecting denitrification in a laboratory loamy sand soil column. The first experiment was conducted under aerobic conditions for 17 weeks while the second was conducted under anaerobic conditions for 3 weeks. Water was added at a rate of 3.75 inches per week in both experiments, While the manure lost about 75% of its nitrogen concentration in experiment one, the soil gained. Approximately 79.6% of the nitrogen lost was due to leaching while the remainder was due to denitrification. Soil was sampled at 4 inch intervals and analyzed for pH, organic matter, ammonium nitrate, nitrate nitrogen, and total nitrogen. Water samples were analyzed for both COD and BOD. Gas analysis equipment problems prevented the successful elimination of atmospheric air in experiment two. It was hoped that replacing atmospheric air with 80% helium and 20% oxygen would enable the chromatograph to detect a change in nitrogen conecentration. (Frantz-East Central).

## 1763-B3, B4, D1, E2, F1

### DRYING ANIMAL WASTES WITH SOLAR ENERGY AND EXHAUST VENTILATION AIR

Agricultural Engineering Department
Purdue University
West Lafayette, Indiana
B. C. Horsfield
Presented at 66th Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-411, 12 p. 14 fig, 22 ref.

Descriptors: *Drying, *Farm wastes, *Ventilation, Confinement pens, Waste treatment, Waste storage, Waste disposal, Computation, Indiana, Costs, Heat, Humidity, Temperature.
Identifiers: *Solar energy, *Computer study, *Solar dryer, *Animal wastes.

A computer study was conducted to determine the technical feasibility of solar dehydration of farm wastes. The process involved the periodic removal of wastes from a slotted or partially-slotted floor, conveyance of waste into a continuously operating exhaust ventilation dryer, and conveyance and spreading of wastes into a solar dryer for ultimate drying and storage until the opportune time for spreading it on crop land. The solar dryer is essentially a large greenhouse with ample ventilation to prevent condensation. A computer simulation for three years of weather in central Indiana indicated that a solar dryer as large as the confinement unit can adequately dry the wastes under typical weather conditions. (Frantz-East Central),

## 1764-A2, A4, A6, A10, B3, D3, E1, E3, F1

### DAIRY WASTE MANAGEMENT

Charles L. Senn
City of Cerritos, California
C. L. Senn
Environmental Protection Agency Report (SW-58d), 1973, 152 p. 49 fig, 21 tab.

Descriptors: *Farm wastes, *Management, *Dairy industry, *Waste treatment, *Waste storage, *Waste disposal, Cattle, Water pollution, Odor, Recycling, Costs.
Identifiers: Composting, Flies.

This report defines and evaluates the major environmental problems in managing solid wastes produced by high-density cow housing located in close proximity to residential developments. This study was conducted through a variety of approaches including public opinion surveys, environmental ranking systems, and actual on-site study of dairy farms. Evaluation is made of the various types of cow housing and solid waste management facilities, from the viewpoint of environmental and economic acceptability. Economic and environmental evaluations of the various systems for utilization or disposal of dairy wastes are also made. Methods and systems which will minimize fly production, odors, and drainage problems from earth corral dairies, especially in wet weather, must be developed. There is also a need for the development of a process to economically and efficiently compost manure on dairy farms. (Senn-Cerritos, California).

## 1765-A11, B2, B4, D1

### MANURE GASES KILL 25 HEAD IN OHIO

A. Mackiewicz
Hoard's Dairyman, Vol. 119, No. 19, p. 1160, October 10, 1974. 1 fig.

Descriptors: *Gases, *Farm wastes, *Cattle, *Ohio, Ventilation, Waste storage, Dairy industry,
Identifiers: *Manure, *Slatted floor building, *Agitator.

Twenty-four bred heifers and a bull were found dead in a slatted floor barn where they had been overcome by gas from a liquid manure pit. An agitator, used to break down solid manure into a slurry, created the gases in the air. The ventilation fans didn't pull out enough gases and the animals were killed. D. W. Bates, extension agricultural engineer, University of Minnesota, gave recommendations for agitation and pumping in slatted floor buildings. A high capacity ventilation system usually will exchange air in the building rapidly enough to keep gas concentrations below lethal levels, but the only completely safe way to protect animals from the toxic effect of gases is to turn them out of the building. (Cameron-East Central).

## 1766-A11, B2, D3

### WINTER PERFORMANCE AND THERMAL ENVIRONMENT OF SWINE IN A MODIFIED OPEN-FRONT HOUSE

D. D. Snethen
MS Thesis, Kansas State University, Manhattan, Department of Agricultural Engineering, 1971, 92p. 31 fig, 17 tab, 58 ref.

Descriptors: *Hogs, *Temperature, *Confinement pens, *Farm wastes, *Waste disposal, Heat transfer, Kansas, Oxidation, Instrumentation, Thermometers, Feeds, Thermal conductivity, Thermal insulation.
Identifiers: *Thermal environment, *Weight gains, Psychrometer, Thermocouple, Dry-bulb, Black-globe.

Previous studies of swine performance showed that the optimum air temperature for hogs varies from 61°F to 73°F depending upon hog weight. An open-front building was constructed in 1968. For the 1970-71 winter the open-front was covered with plywood and clear polyethylene. Propane burning radiant heaters were installed over the hogs' sleeping area. Comparisons were made between hog performance of the 1968-69 and 1969-70 winters and the 1970-71 winter, It was found that growing and finishing the hogs was successfully aided by the modifications. Daily weight gains were significantly improved over swine housed in an unmodified building. Ventilation requirements were reduced because moisture was condensed on the polyethylene film and ran out of the building. The modification also allowed a liquid manure oxidation pit to operate throughout the winter without impairment from freezing. (Frantz-East Central).

## 1767-A5, A8, B2, B3, C2, D3, E2

### MANURE WASTE PONDING STUDY

California State Water Resources Control Board
D. Baier, J. L. Meyer, and D. R. Nielsen.
Contribution from the Cooperative Extension and the Agricultural Experiment Station of the University of California and the California State Water Resources Control Board, Sacramento, 14 p. 4 fig, 3 tab.

Descriptors: *Farm wastes, *Waste storage, *Waste disposal, *Groundwater pollution, *Nitrates, Leakage, Denitrification, Biochemical oxygen demand, Salts, Tensiometers, Poultry, Soils, Percolation.
Identifiers: *Holding ponds, *Manure.

Seventeen manure holding ponds were studied to determine rates at which the ponds sealed against leakage into underlying groundwater, rates of denitrification in the ponds and stratification of chemical constituents and BOD within the ponds. Additionally, the fate of nitrates and other salts were evaluated when field-dried manure was applied as fertilizer. Tensiometric techniques were used to determine hydraulic potential gradients and to obtain samples of the soil solution beneath the ponds. The solutions were analyzed for pH, total dissolved solids (TDS), and nitrates. In addition to the analyses of the solution, soil samples taken by auger just outside the edge of the ponds from the same depths were analyzed for nitrates and TDS, Even on coarse textured soils, ponds effectively sealed in 60 days or less. Almost no salt was lost from the ponds, but there was substantial denitrification. Applications of 40 yards of manure per acre resulted in higher nitrates in percolating leachates and slightly higher salinity than applications of 12 yards of manure per acre. (Cameron-East Central).

## 1768-A11, B3, E3

### IS TOTAL RECYCLING OF HEN MANURE POSSIBLE?

Poultry Digest, Vol. 32, No. 373, p. 130, March, 1973.

Descriptors: *Poultry, *Recycling, *Farm wastes, Fermentation, Digestion, Cellulose.,
Identifiers: *Manure, Polysaccharides, Hemicellulose, Microbial decomposition, Thermal decomposition.

Studies in the USDA's Agricultural Research Service laboratory and at Michigan State University point to methods for converting all manure from caged laying hens to feed for the hens. Caged hens are now fed a ration of 25% dehydrated poultry waste. Refeeding at a level of 30% would allow total recycling of the waste. An absence of fiber buildup in recycled hen manure suggests that either microbial or thermal decomposition occurs during recycling. Maximizing increases in microbial fermentation and in digestibility in the bird probably will permit refeeding at the 30% level, or total recycling. (Cameron-East Central).

## 1769-B1, B5, D2, E3

### CONVERTING ANIMAL WASTES TO OIL

Area Resource Development Agent
Cooperative Extension Service
Pennsylvania State University
D. A. Harter,
Pennsylvania Township News, Vol. 27, No. 4, p. 26-27, April, 1974.

Descriptors: *Farm wastes, *Oil, *Fuels, *Waste treatment, *Waste disposal, *Recycling, Cellulose, Energy, Air pollution, Pressure, Sulfur, Economics, Pennsylvania.
Identifiers: *Pyrolysis, *Manure, Carbon monoxide.

Scientists at the Research Center in Pittsburgh have discovered that by a pyrolysis technique, manure can be converted to oil. The manure is placed in a reaction vessel with carbon monoxide at a pressure of 4000 p.s.i. and heated with little or no oxygen to 662-752°F for 15 minutes. Based on dry manure, the yield of oil is three barrels per ton. The oil produced has an energy content of 14,000 to 16,000 B.t.u. per pound compared to normal oil's B.t.u. value of 20,000. This source of energy is low in sulfur—an important property due to the need for low-sulfur oils to alleviate air pollution. Pyrolysis research on agricultural wastes has been strictly experimental to date. Due to the experimental nature of the work definite information on costs is now available. (Cameron-East Central).

## 1770-A4, B2, B3, D1, E2, F1

### COSTS NOTED FOR SOLID AND LIQUID WASTE SYSTEM

Feedlot Management, Vol. 15, p. 58, January, 1973.

Descriptors: *Waste storage, *Waste disposal, *Liquid waste, *Farm wastes, *Costs, *Solid wastes, Settling basins, Lagoons, Irrigation, Legal aspects, Missouri.
Identifiers: *Manure, *Land disposal.

An animal waste disposal system was developed that meets Missouri law with respect to keeping waters of the state clean. Basically, the system involves returning waste solids and liquids to agricultural land and preventing them from getting into water resources. The liquids are drained off into a lagoon; the solids settle out in the settling basin. Solids are deposited on the land by using a conventional manure spreader. The liquids are spread through irrigation equipment. The annual costs to own and operate the system range from a low of 75c per head for a 400-head operation using the hand carry system to a high of $1.37 per head for a 1,200 head operation using the traveling gun system. (Cartmell-East Central),

## 1771-A11, B3, C2, E3

### DPW'S POULTRY FEED VALUE IS LIMITED

Manager, Meat Bird Research Division
Ralston Purina Company
St. Louis, Missouri
K. E. Rinehart
Poultry Digest, Vol. 33, No. 386, p. 158-159, April, 1974. 5 tab.

Descriptors: *Poultry, *Feeds, *Waste disposal, Amino acids, Calcium, Corn, Energy.
Identifiers: *Dehydrated poultry wastes (DPW), *Refeeding, Broilers, Hens, Excreta, Egg weight, Feed conversions, Purina Research Farm.

Studies indicated that the value of dehydrated poultry waste (DPW) as a feed ingredient for poultry and livestock is limited. Metabolizable energy determinations indicated DPW to have approximately 6% of the energy value of corn for hens; whereas, there was no energy volume in broilers and hens fed the DPW, indicating poor utilization. When rations were lowered to 80% of the amino acid level felt to be required, there was a numerical enhancement of production and egg weight. Feed conversions were depressed as level of DPW increased, suggestive of a lower energy worth than assigned. Extrusion of DPW fed in a ration with an excess of amino acids (110%) failed to enhance the energy value measured by feed consumption. It is concluded that DPW has no value for the young broiler with a value up to 6% of corn for hens. (Cameron-East Central).

## 1772-A11, B3, E3

### DRIED POULTRY MANURE NOT TOO EFFECTIVE IN LAYING HEN FEEDS

Arkansas University
P. W. Waldroup and K. R. Hazen
Arkansas Farm Research, Vol. 23, No. 3, p. 10, May-June, 1974. 1 tab.

Descriptors: *Poultry, *Farm wastes, *Feeds, *Diets, Waste disposal, Production, Mortality, Energy.
Identifiers: *Dried Poultry Waste (DPW), *Refeeding, *Laying hens.

Recently there have been a number of studies at laboratories regarding use of dehydrated poultry manure in poultry diets, especially in diets of laying hens. The following study was conducted to assess the value of this practice. Diets were formulated which contained 0, 5, 10, 15, 20, and 25% dehydrated poultry manure. The diets were fed for 112 days and records were kept on rate of production, feed consumption, egg size, and interior egg quality. Mortality during the trial was minimal and not influenced by dietary treatment. No significant differences were observed in egg size, but the interior albumen quality increased with the use of poultry waste. This can be attributed in large part to the reduction in rate of egg production. Daily feed intake increased as the amount of poultry waste in the diet increased. The energy content of the poultry manure is probably less than 400 M.E. kcal/lb. Because of this, it probably would not be a useful ingredient in diets in which high-energy feedstuffs are desired. (Cartmell-East Central).

## 1773-B1, C1, C2, D1

### DAIRY CATTLE MANURE LIQUID: SOLID SEPARATION WITH A SCREW PRESS

J. R. Menear and L. W. Smith.
Journal of Animal Science, Vol. 36, No. 4, p. 788-79 April, 1973. 2 tab, 8 ref.

Descriptors: *Dairy industry, *Cattle, *Farm wastes, *Physical properties, *Chemical properties, *Waste disposal, Proteins, Nitrogen, Liquid, Organic matter.
Identifiers: *Screw press, *Press cake, Dry matter, Cell walls.

It is hoped that mechanical separation of the substances present in livestock manure may provide alternative and more economical methods for manure management and utilization. A continuously-fed screw press fractioned manure into two totally different fractions. The manure press cake was high in cell wall content (70.0%). The liquid was high in crude protein content (49.6%) on a dry basis. Actual description of the screw press, the fractionating experiments, and their results are discussed. (Merryman-East Central).

## 1774-A7, A11, B1

### EFFECT OF ATMOSPHERIC AMMONIA AND THE STRESS OF INFECTIOUS BRONCHITIS VACCINATION ON LEGHORN MALES

Department of Animal Sciences
Colorado State University
Fort Collins
H. F. Kling and C. L. Quarles
Supported by the Colorado State University Experiment Station and published as Scientific Series Paper 17 p. 2 fig, 4 tab, 14 ref.

Descriptors: *Poultry, *Ammonia, *Stress, *Farm wastes, *Pollutants.
Identifiers: *Leghorn males, *Infectious bronchitis vaccination.

Ammonia at levels of 0, 25 or 50 parts per million (p.p.m.) was introduced into 12 controlled-environment chambers containing male Leghorn chicks. Ammonia was introduced continuously into the test chambers from the 4th to 8th week of the experiment. An infectious bronchitis vaccination was administered to all chickens at 5 weeks of age. Body weights and feed efficiencies were determined at 4, 6 and 8 weeks of age. At 4, 5, 6 and 8 weeks of age lung and bursae of Fabricius weights, hematocrits and air sac scores were determined. Body weights and feed efficiencies were significantly reduced in the ammonia chambers. The bursae of Fabricius of the ammonia-stressed chickens were significantly larger than those of controls at 5 weeks of age and significantly smaller at 8 weeks of age. Chickens grown in ammoniated environments had significantly larger lungs at 8 weeks. Hematocrits were not significantly different among the treatments. Total air sac scores were significantly higher in the ammonia-stressed chickens at 8 weeks. Results indicated that chickens are affected by the stress of ammonia at levels of 25 or 50 p.p.m. and infectious bronchitis vaccination. (Kling and Quarles—Colorado State University).

## 1775-A1, A4, B1, F1, F2

### ECONOMIC IMPLICATIONS OF WATER POLLUTION ABATEMENT IN FAMILY FARM LIVESTOCK PRODUCTION

Economics Division, Economic Research Service, United States Department of Agriculture, Urbana, Illinois, and East Lansing, Michigan, respectively.
R. N. Van Arsdall and J. B. Johnson.
United States Department of Agriculture, Economic Research Service report ERS-508, December, 1972, 44 p. 3 fig. 27 tab.

Descriptors: *Economics, *Water pollution control, *Farm wastes, *Management, *Livestock, *Legal aspects.
Identifiers: *Animal wastes, *Family operated farms.

A high-quality environment is important to farmers, but impediments to change exist: (1) Farmers and lenders are not certain of the performance of alternative methods of pollution control or the level of environmental quality that will eventually be required; (2) The market offers no economic incentive to change; (3) Diseconomies of size exist; (4) Age and tenancy make durable investments unattractive; and (5) Technical assistance is not yet available in the amount that will be required by new and pending legislation. State water pollution control statutes that apply to livestock production in the Northeast and North Central Regions are summarized. (Merryman-East Central)

## 1776-A1, A4, B1, B4, C1, C2, C3, E1, F1, F2, F4

### POLLUTION IMPLICATIONS OF ANIMAL WASTES. A FORWARD ORIENTED REVIEW

Kansas University
Department of Civil Engineering
Lawrence
R. C. Loehr
FWPCA Project, Kerr Water Research Center, Ada, Oklahoma, July 1968, 175 p. 12 fig, 4 tab, 141 ref.

Descriptors: *Cattle, *Hogs, *Poultry, *Farm wastes, *Waste disposal, Costs, Legal aspects, *Water treatment, Water pollution sources, Pollution abatement, Water pollution.
Identifiers: *Animal wastes.

The purpose of this review was to present a forward oriented state-of-the-art of pollutional implications which must be faced with the ever increasing trend toward confinement feeding large numbers of livestock. The manure wastes from all varieties of livestock under feed in the United States are characterized and related both to human population equivalents and beef cattle equivalents. The potential environmental hazards which may result from improper handling, storage, and disposal of these wastes were discussed. The effectiveness and economics of various conventional wastes treatment and disposal methods as related to confinement feeding wastes were evaluated. (Shuyler-EPA).

## 1777-A8, B2, C2, E2, F6

### MOVEMENT AND TRANSFORMATION OF MANURIAL NITROGEN THROUGH SOILS AT LOW TEMPERATURES

Agricultural Engineering Department
Wisconsin University
Madison
M. F. Walter, G. D. Bubenzer, & J. C. Converse.
Sixth National Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, 26 p. 6 fig, 5 tab, 23 ref,

Descriptors: *Nitrogen, *Movement, *Soils, *Farm wastes, *Temperature, *Mathematical models, Livestock, Soil profiles, Ammonia, Evaporation, Liquid wastes, Dairy industry.
Identifiers: *Transformation.

Livestock waste has been implicated as a major source of environmental nitrogen pollution. An approach to the development of a quantitative mathematical model which predicts the concentration of nitrate in the soil solution based on empirical equations for the principal nitrogen transformations is described. This information is then combined with equations describing the movement of water and dispersion of nitrate through the soil profile. Parameters for equations to be used with the model were based on laboratory studies with Plainfield sand and heavy ammonium applications in the form of liquid dairy waste. The model was designed to quantitatively predict movement of relatively large quantities of nitrate in the soil solution, and it is particularly suited for heavy applications of ammonium because the early spring conditions for which it was developed occur for only a few months. The present model does not include plant uptake of nitrogen nor soil water movement due to evaporation. Therefore, the model is not applicable to systems with appreciable living vegetation nor can it be used in systems where evaporation has a significant effect on soil water movement. (Cartmell-East Central).

## 1778-B2, B3, B4, D1, E2, F1

### MODELS FOR HANDLING SOLID MANURE

Associate Swine Editor
B. Eltink and L. Searle
Successful Farming, Vol. 71, No. 11, p. 28-30, October, 1973.

Descriptors: *Solid wastes, *Farm wastes, *Management, Feed lots, Hogs, Cattle, Waste storage, Irrigation, Lagoons, Runoff, Costs, Capacity, Illinois,
Identifiers: *Manure, *Handling.

Solid waste handling systems are discussed. One waste system requires less than 50 hours per year handling manure from 2,500 hogs. It utilizes 100 feet lengths of perforated polyvinyl chloride plastic pipe for irrigation holding pond water. Costs, capacities and problems of irrigating, scraping, storing and stacking animal wastes are discussed. (Frantz-East Central).

## 1779-A4, A8, B1

### THE NITROGEN REGIME OF BEEF CATTLE FEEDLOT SOILS

Nebraska University
J. Boyce
PhD Thesis, Agricultural Engineering Department, University of Nebraska, 1970, 73 p. 21 fig, 5 tab, 22 ref.

Descriptors: *Nitrogen, *Feed lots, *Farm wastes, *Soils, *Cattle, Nitrates, Nitrites, Model studies, Anaerobic conditions, Aerobic conditions, Water pollution.

This study was carried out in model systems to determine the fate of applied nitrogen under simulated feedlot conditions and to examine the factors that influence the nitrogen regime of feedlot soils. The accumulation and form of nitrogen in soil materials incubated under simulated feedlot conditions were dependent upon the soil material, the rate of urea application, and the temperature-moisture regime of the incubations. The data indicated that the majority of the nitrogen added to feedlot soils is lost as NH3. Nitrates were found to persist in feedlot soils and manure in spite of anaerobic conditions. The rate of nitrogen loss from manure (feces and urea) was increased by the addition of 10 ppm N-Serve under aerobic conditions and by anaerobic conditions in the absence of N-Serve. It is suggested that feedlot soils can be managed in such a manner as to significantly increase the loss of N as NH3. Maximizing NH3 volitilization and maximizing the distance between feedlots and surface water may result in a minimizing of the detrimental environmental effects often associated with beef cattle feeding operations. (Cartmell-East Central)

## 1780-A1, B1, F1, F4

### THE PROBLEM OF FARM ANIMAL WASTE DISPOSAL

Department of Agricultural Engineering
Ohio State University, Columbus
E. P. Taiganides
Management of Farm Animal Wastes, Proceedings National Symposium on Animal Waste Management, American Society of Agricultural Engineers, Michigan State University, May 5-7, 1967, p. 5-8. 1 tab, 10 ref.

Descriptors: Farm wastes, *Waste disposal, *Livestock, *Poultry, *Confinement pens, Lagoons, Odor, Runoff, Water pollution, Costs.
Identifiers: *Animal wastes, Land application.

Animal wastes are one of the six sources of farm wastes whose management and disposal have become one of the most challenging problems of modern farming. The factors which cause and/or aggravate the animal waste disposal problem are: properties of animal wastes, current methods of livestock and poultry production, expansion of urban centers into rural areas plus public awareness of the need for healthy and aesthetically pleasant environment, and inadequacy of present methods of manure handling and disposal. On the basis of population equivalence data reported by Taiganides and Hazen (1966) the daily wastes from poultry, swine, and cattle alone are equivalent to 10 times the wastes of the human population of the United States. American animal producers seek waste disposal methods which have low labor requirements, reduce nuisance conditions, and improve sanitation. They are limited by lack of technical information and by the misconception that they should be able to dispose of manure at no extra cost. This lack of both the basic and applied knowledge necessary for successful handling, treatment, and disposal of farm wastes makes research in this area a unique challenge. (Marquard-East Central).

## 1781-A2, A4, B2, B4

### THEY'RE GETTING THE JUMP ON POLLUTION CONTROLS

R. Graves and C. Hartman
Hoard's Dairyman, Vol. 119, No. 12, p. 468, June 25, 1974. 1 fig.

Descriptors: *Water pollution, *Control, *Confinement pens, *Farm wastes, *Runoff, *Diversion, Dairy industry, Waste storage, Livestock.
Identifiers: Manure, Environmental Protection Agency.

Farmers in Lafayette County, Wisconsin, are demonstrating that they will respond to positive, sensible programs aimed at controlling pollution and stream degradation from confinement livestock operations. With impetus provided by the county extension office and soil and water conservation district, many groups and agencies are involved in making the "Environmental Eye" a community project. The idea behind this project began in the spring of 1972. An environmental eye is both a real thing and a "gimmick." Looking at a hillside farmstead as an eyeball, a diversion up hill from the buildings forms an eyelash. A collection channel or diversion below the buildings completes the eye. These two diversions are important parts of any barnyard runoff control project. For most small yard situations, the diversion of water from above the barn prevents manure from being flushed or washed out of yards or storage areas. Rain falling directly on the yard will wash away little manure. This usually can be controlled by directing it away from streams or ditches to nearby pasture or cropland. If more control is necessary, a solids separation area, detention pond, or both, can be added at the end of the collection channel. (Cartmell-East Central)

## 1782-A4, B2, C1, C2, F4

### POLLUTION ASPECTS OF CATFISH PRODUCTION — REVIEW AND PROJECTIONS

Agriculutural Engineering Department
Georgia University
Athens, Georgia
J. C. Barker, J. L. Chesness, and R. E. Smith.
Environmental Protection Technology Series Report EPA660/2-74-064, July, 1974, 121 p. 24 fig. 25 tab, 51 ref.

Descriptors: *Fish farming, *Catfishes, *Water pollution, *Organic wastes, Ponds, Effluent
Identifiers: Waste concentrations, Waste discharge, Biological organic removal, Raceways.

A literature review and field study was undertaken to determine the waste concentrations and discharge loadings occurring in the waters from catfish-culturing ponds and raceways. Water quality analyses were performed on samples taken during a 240-day growing season and at drawdown (assuming drainage at harvest). The natural biological degradation of the raw wastes in the ponds and raceway systems resulted in BOD reductions of 96.8% and 98.0% respectively when compared to waste levels produced in indoor single pass tank systems with no waste removal facilities. Reductions in total nitrogen of 97.2% and 97.7% occurred in ponds and raceways respectively, while ammonia nitrogen was reduced by 94.4% and 99.4% respectively. Sedimentation and biodegradation resulted in an 83.6% reduction in suspended solids in ponds and an 96.2% suspended solids reduction in raceways. Total phosphate levels were reduced by 98.5% and 97.4% in ponds and raceways respectively. (Chesness-Georgia University).

### 1783-A5, A8, B2, C2, E2

### QUALITY IMPROVEMENT OF FEEDLOT LAGOON WATER BY PERCOLATION THROUGH SOIL UNDER NATIVE PASTURE

Kansas Water Resources Research Institute
Manhattan.
W. L. Powers, L. S. Murphy, and B. R. Bock.
Contribution No. 131. January 1974. 50 p. 15 fig. 14 tab. 1 ref.

Descriptors: *Feedlots, *Percolation, *Soil chemical properties, *Water reuse, *Waste water treatment, *Bromegrass, *Phosphorus, Groundwater, Potassium, Absorption, Nitrogen.

Beef feedlot retained in catchment lagoons was applied as an irrigant for bromegrass to determine the effects of this practice on bromegrass yields, bromegrass N, P, K concentrations and uptake, selected soil chemical properties, and groundwater quality beneath the application area. Average applications of 9.3 and 19.0 cm of well water in one irrigation season produced no consistent differences. Lagoon water applications produced an accumulation of extractable K in the soil profile at the 0-to 30-cm depth for all treatments; largest accumulation was observed in the straight lagoon water treatment, an increase of from 470 to 588 ppm. Although approximately twice as much P was added in the lagoon water treatments as was removed by the bromegrass in one growing season, the average weak Bray extractable P for the 0-to 300-cm depth and for the 0-to 30-cm depth decreased for all treatments. After the first season of lagoon water applications, a moderate increase in the average water soluble C1- content of from 3 to 5 ppm was observed for the 0-to 300-cm depth. Analyses of groundwater samples from beneath the application area at depths of 7.6 and 21m revealed highly significant differences between these depths relative to concentrations of NO3--N, Ca, Mg, K, Na, C1-, and electrical conductivity values. Concentrations greater than 10 ppm for NO3--N in the shallow wells were common while the mean for all NO3--N values from the deep wells was 0.04 ppm. Mean values of 0.12 and 0.11 ppm were found for NH4+-N in the shallow and deep wells respectively. (Power-Kansas Water Resources Research Institute).

### 1784-B2, D3, F1

### THE WATER BUDGET AND WASTE TREATMENT AT A MODERN DAIRY

Water Resources Research Institute
Mississippi State University
State College
J. B. Allen, J. F. Beatty, S. P. Crockett, and B. L. Arnold
Completion Report, July 1973. 30 p. 15 fig. 3 tab, 7 ref.

Descriptors: *Dairy industry, *Hydrologic budget, *Waste treatment, *Mississippi, *Waste water treatment demand, lagoons, Industrial wastes, Biochemical oxygen demand.

This study was concerned with an analysis of the dairy water budget and an evaluation of the efficiency of a 2-cell lagoon waste treatment system for a modern 130-cow dairy at Holly Springs, Mississippi. The water budget at the dairy was determined by means of water meters installed on the main supply line, the alley flushing system, the milking parlor flush tanks, the prep stalls, the milk-room and the watererers. Data collection began on June 15, 1972, and continued through June 15, 1973. The water budget was summarized on a weekly basis by means of a computer print-out. For an average of 114 cows, the average water usage was 16,738 gallons per day (gpd). The amounts of water used in the various components of the dairy were: alley flushing systems, 5,372 gpd; milking parlor flush tanks, 6,869 gpd; prep stalls, 809 gpd; milk-room hot water, 320 gpd; cattle waterers, 2,113 gpd; and miscellaneous, 1,255 gpd. The BOD of the milking parlor wastes entering the first cell of the waste treatment system averaged 699 mg/1, and the BOD of the free stall alley wastes entering the first cell averaged 758 mg/1. The overall treatment efficiency of cell 1 (reduction in BOD) was 62.9%. The overall treatment efficiency of cell 1 plus cell 2 was 86.5%.

### 1785-A4, A7, A12, B1

### NITROGENOUS COMPOUNDS IN THE ENVIRONMENT

Environmental Protection Agency, Washington, D. C, Hazardous Materials Advisory Committee.
Environmental Protection Agency Report EPA-SAB-73-001, December, 1973, 187 p.

Descriptors: *Feed lots, *Waste water treatment, *Water pollution control, *Nitrogen compounds, *Farm wastes, Landfills, Ecology, Water pollution, Water pollution effects, Groundwater, Runoff, Urban areas, Sewage, Industrial wastes, Sanitary engineering, Air pollution, Nitrites, Fertiliers, Wastes, Food supply.
Identifierzs: Sanitary landfill leachate, Nitrosamines.

This report is a series of papers on the sources and methods of control and the environmental health effects of nitrogenous compounds. Diverse aspects of municipal and industrial sources are discussed—waterborne, atmospheric, agricultural, and industrial processes generating nitrogenous compounds. Attention is given to nitrogenous materials in waste and surface waters, efficiency of sewage treatment, effectiveness of the conventional BOD test, and the contribution of urban runoff and landfill leakage to the overall nitrogen load in the environment. Concentrations, sources, sinks, the transformation of nitrogenous materials in the lower atmosphere, control measures for stationary and mobile sources, retrofit systems for used cars, and new engine systems are reviewed. Plant nutrients, including fertilizers, and animal wastes are considered. The growing problems resulting from concentrated centralized livestock feedlots and methods of control are pointed out. Nitrogen is discussed as a nutrient essential to living organisms and as a toxicant within the aquatic environment. The carcinogenicity of nitrosamines and their precursors is described as a potential danger to health. Individual nitrogenous compounds are appropriately identified through the report. Analytical procedures for the identification and quantification of nitrogenous compounds are reviewed. Presented are the major concerns regarding nitrogenous compounds in the environment as these related to the following EPA activities: research, monitoring, and regulation. (Malone-EPA).

### 1786-A4, A5, A11, A12, C2

### NATURE AND HISTORY OF THE NITRATE PROBLEM

Department of Veterinary Medicine and Surgery
School of Veterinary Medicine.
University of Missouri
Columbia
A. A. Case, G. Garner, G. E. Smith, and W. H. Pfander.
Science and Technology Guide, University of Missouri Extension Division, 1964, p. 9800-9801.

Descriptors: *Nitrates, *Nitrites, *Farm wastes, *Pollutants, *Water pollution, *Forages.
Identifiers: Methomoglonemia, Fuming silos, Animal wastes.

Excessive nitrate content of forage plants and "loaded" water supplies is being recognized in the corn belt states (Kansas, Iowa, and Missouri) as a serious problem. The major cause of these excessive nitrates seems to be animal wastes. Fuming silos are another source of nitrate poisoning. Fuming silos are grain storage silos which give off an often lethal gas during the filling and a week or so afterwards. This gas comes from forage that contains excessive amounts of nitrate or nitrite, but the amount doesn't have to be very high. Juice draining from fuming silos is also a dangerous toxic agent for anything exposed to it. Nitrate poisoning of human infants and of livestock is discussed. Symptoms are described. (Drewry-East Central).

### 1787-A5, A8, A9, C2, E2

### ESTABLISHING THE IMPACT OF AGRICULTURAL PRACTICES IN GROUNDWATER QUALITY

Department of Soil
Minnesota University
Minneapolis
R. G. Gast and P. R. Goodrich.
Paper No. 1549 Miscellaneous Journal Series, Minnesota Agricultural Experiment Station, University of Minnesota, p. 79-91. 1 fig. 4 tab, 9 ref.

Descriptors: *Water pollution sources, *Groundwater, *Farm wastes, *Fertilizers, Nitrogen, Water quality, Nitrates, Water pollution.
Identifiers: Groundwater pollution.

Agricultural croplands constitute about 33% of the total land area of the state of Minnesota and consequently overlay extensive groundwater reserves. Agricultural practices on these lands often involve application of large quantities of herbicides, pesticides, and nitrogen, phosphorus and potassium in fertilizers and animal wastes which pose potential threats to groundwater quality. All of these materials except nitrogen are strongly absorbed by the soil and pose little threat to groundwaters. Nitrogen (as nitrate) is mobile and will move into groundwater if allowed to accumulate in the soil. Optimum crop yields can be sustained without nitrate accumulations in the soil if proper fertilization rates are used. If animal wastes are concentrated in a small area, they move almost directly into the groundwater by such mechanisms as sinkholes and defective well casings or by saturated flow through soils. Contamination of groundwaters from such sources can be minimized by locating larger operations consistent with proper soil and hydrologic conditions. (Knapp-USGS)

### 1788-A2, C3

### MICROBIAL POPULATION OF FEEDLOT WASTE AND ASSOCIATED SITES

Agricultural Research Service
Peoria, Illinois
R. A. Rhodes and G. R. Hrubant
Applied Microbiology, Vol. 24, No. 3, p. 369-377, September, 1972. 4 fig, 1 tab, 14 ref.

Descriptors: *Farm wastes, *Feed lots, *Cattle, *Runoff, *Pollutant identification, *Microorganisms, Confinement pens, Coliforms, Anaerobic bacteria, Yeasts, Fungi, Water pollution sources, Sampling, Methodology, Bacteria, Isolation, Soil disposal fields, Domestic animals, Ruminants, Analytical techniques.
Identifiers: Sample preparation, Culture media, Streptomycetes, Enumeration.

A quantitative determination was made every 2 months for a year of the microflora of beef cattle waste and runoff at a medium-sized midwestern feedlot. Counts were obtained for selected groups of organisms in waste taken from paved areas of pens cleaned daily and, therefore, reflect the flora of raw waste. Overall, in terms of viable count per gram dry weight, the feedlot waste contained 10 billion total organisms, one billion anaerobes, 100,000,000 gram-negative bacteria, 10,000,000 coliforms, 1,000,000 sporeformers, and 100,000 yeasts, fungi, and streptomycetes. The specific numbers and pattern of these groups of organisms varied only slightly during the study in spite of a wide variation in weather. Data indicate that little microbial growth occurs in the waste as it exists in the feedlot. Runoff from the pens contained the same general population pattern but with greater variation attributable to volume of liquid. Comparable determinations of an associated field disposal area (before and after cropping), stockpiled waste, and elevated dirt areas in the pens indicate that fungi, and especially streptomycetes, are the aerobic organisms most associated with final stabilization of the waste. Yeasts, which are the dominant type of organism in the ensiled corn fed the cattle, do not occur in large numbers in the animal waste. Large ditches receiving runoff and subsurface water from the fields have a population similar to the runoff but with fewer coliforms. (Holoman-Battelle).

## 1789-A6, B1, B5, C2

### SWINE FECAL ODOR AS AFFECTED BY FEED ADDITIVES

S. H. Ingram, R. C. Albin, C. D. Jones, A. M. Lennon, L. F. Tribble, et al.
Texas Tech Laboratory
Lubbock
Presented at the Annual Meeting, American Society of Animal Science, Southern Section, Atlanta, Georgia, February 4-7, 1973, 5 p, 6 tab.

Descriptors: *Hogs, *Farm wastes, *Odor, *Feeds, *Additives, Sampling, Diet, Volatility, Yeasts, Texas Chromatography, Air pollution.
Identifiers: *Swine, Skatole, Indole, Lactobacillus acidophilus.

A grain-soybean meal diet was fed to 4-week-old hogs. Fecal samples were evaluated by olfactory panels. Reduction in volatile matter was scaled by using comparisons between the basal diet and dietary treatments. A lyophilyzed yeast culture and a commercial preparation of Lactobacillus acidophilus reduced the skatole and indole content of the feces, but changes in volatile matter were not detected. (Frantz-East Central).

## 1790-B1

### A FAECES COLLECTOR SUITABLE FOR MALE CALVES

Immunology Unit, Department of Veterinary Surgery,
Royal (Dick) School of Veterinary Studies
Summerhall, Edinburgh
E. F. Logan, and D. J. Ormrod.
The Veterinary Record, Vol. 93, No. 4, p. 104-105, July 28, 1973. 2 fig, 4 ref.

Descriptors: *Farm wastes, *Cattle, Adhesives.
Identifiers: *Faeces collector, *Male calves.

Using latex rubber adhesive, Logan and Ormrod designed a faeces collector suitable for male calves, A cast was made out of the hindquarters of a new-born Ayrshire calf. Using plastic and glass containers which were held in position by plaster of paris bandage, the cast was built up into a conical shape. The mould was covered with layers of rubber latex adhesive and surgical gauze to a thickness of 1/8". Webbing straps with buckles were fixed to the collector by contact adhesive—two dorsally, two ventrally and two latterally. To the end of the latex cone a long, 5 in. wide nylon sleeve was attached. The collector was fitted over the calf's rump and fastened by the straps to a webbing body belt, which was fixed to a collar around the calf's neck to prevent the body belt slipping backwards. The collector has proved to be effective, very durable and easily cleaned. The use of latex rubber and gauze gives the collector elasticity, allowing faeces to be efficiently channelled into the nylon sleeve even when calves are recumbent. (Cameron-East Central).

## 1791-A8, B2, C1, C2, C3, E2

### PROCESSED ANIMAL WASTE EFFLUENT DISPOSAL IN SOIL BY A PRESSURIZED SUBSURFACE SYSTEM

F. S. Chuang
PhD Thesis, University of Massachusetts, Amherst, June, 1971, 155 p. 51 fig, 22 tab, 70 ref.

Descriptors: *Farm wastes, *Effluent, *Waste disposal, *Soils, Pollutants, Sewage, Irrigation, Chemical characteristics, Physical characteristics.
Identifiers: *Animal wastes, *Subsurface disposal system.

This study was undertaken to determine reliable subsurface waste disposal procedures and to study the effects of flow through the soil of processed animal waste effluent on the quality of percolate water and soil environment systems. The experiments were satistically designed for two treatments of soil bulk density and four treatments of flow with three replications. In order to show the reliability of the comparison for (1) the degree of tertiary treatment by the soil, (2) chemical and microorganism characteristic changes in the soil, and (3) the results of flow rate, two confidence levels (99% and 95%) were selected. Data revealed that once-a-week dosing was an efficient treatment when used in a subsurface disposal system. It was concluded that the waste stabilization system utilized provided a final effluent which was suitable for this system of disposal. (Russell-East Central).

## 1792-A2, C1, C2, E1, E2, F1

### SOME PHYSICAL AND ECONOMIC ASPECTS OF WATER POLLUTION CONTROL FOR CATTLE FEEDLOT RUNOFF

Texas Tech University
Lubbock
T. R. Owens, D. Wells, W. Grub, R. C. Albin, and E. Coleman.
Unpublished Paper, Texas Tech University, Lubbock, 20 p. 9 tab.

Descriptors: *Water pollution, *Control, *Runoff, *Farm wastes, *Feed lots, *Cattle, *Economics, *Waste treatment, *Waste storage, *Waste disposal, Costs, Texas, Chemical properties, Irrigation, Basins, Model studies, Rainfall, Evaporation, Performance.
Identifiers: Land disposal, Slotted floors, Manure, Playa lake disposal.

Quantitative and qualitative aspects of feedlot runoff are studied. Average concentrations of pollutants in feedlot runoff are determined. Collection basin designs were discussed as runoff control measures. Comparative operating and investment costs are approximated with limitations discussed. Open land disposal has been attempted but modified environmental feeding on slotted floors is recommended as an approach to the problem. Pros and cons of the latter are discussed, (Wetherill-East Central).

## 1793-A2, A5, A8, A9

### DISPERSION DURING FLOW IN POROUS MEDIA WITH BILINEAR ADSORPTION

School of Chemical Engineering
Purdue University
West Lafayette, Indiana
S. P. Gupta and R. A. Greenkorn
Water Resources Research Vol. 9, No. 5, p. 1357-1368, October, 1973. 4 fig, 27 ref.

Descriptors: *Dispersion, *Flow, *Porous media, *Bilinear adsorption, *Groundwater pollution, *Measurement, Feed lots, Runoff, Farm wastes, Fertilizers, Pesticides, Herbicides, Cultivated lands, Domestic_ wastes, Industrial wastes.

Major sources of the pollution in underground water are various compounds that may come from the runoff of cattle feedlots, from the runoff of fertilizers, pesticides, and herbicides from the cultivated lands, and from domestic and industrial wastes. In this paper the solution is presented for a bilinear rate of adsorption. This adsorption mechanism was proposed for ion exchange and adsorption columns. The mechanism is appropriate for adsorption in soils and columns of soil. Morever the solution can easily be modified for a first- or second-order rate of adsorption. The equations for the movement of chemicals in porous media with dispersion and adsorption using a bilinear rate of adsorption may be solved by the Crank-Nicolson method for homogeneous porous media. The solution for a field model 100 feet long is reported to 2 pore volumes; 31.6% of the solute is being adsorbed, and the system will require 36.5 pore volumes at saturation. (Cartmell-East Central)

## 1794-A2, A4, A5, A11, A12, B2, D3, E2

### LIQUID MANURE MANAGEMENT FOR SWINE OPERATIONS

Texas Agricultural Extension Service
Texas A&M University System
College Station
B. R. Stewart and J. M. Sweeten
Report MP-1128, Texas Agricultural Extension Service, Texas A&M University, College Station, 8 p., April, 1974. 5 fig, 4 tab.

Descriptors:: *Liquid wastes, *Management, Aerobic lagoons, Irrigation, Design.
Identifiers: *Swine, Storage pits, Anaerobic lagoons, Land disposal, Application rates. Tank wagons, Soil injection.

Swine waste management involves the control of runoff from open lots and management of manure and waste water from confinement systems. The objective of manure handling should be to collect, transport and dispose of waste on land in an efficient and odor-free manner. Two basic approaches to manure handling are solid and liquid handling. Liquid manure handling systems can be characterized according to the methods of collection, storage, treatment and disposal. Liquid manure management systems involve substitution of water and mechanical equipment for labor and bedding. This results in quick separation of the animal from its wastes, improved general sanitation and reduced opportunities for disease transmission. Lagoons provide a means of biological treatment and storage of liquid manure from confinement swine buildings. Regardless of the manure handling or treatment system employed, raw or treated waste should ultimately be disposed of on pasture or crop land in a manner that will reuse nutrients and prevent pollution of surface and ground water. (Cameron-East Central).

## 1795-A6,A11,B2,C2,D3,E3

### HARVESTING NUTRIENTS FROM SWINE WASTES

Department of Animal Science
University of Illinois
B. G. Harmon.
Proceedings of 23rd Annual Minnesota Nutritions Conference, 1972, 8 p. 10 tab, 16 ref.

Descriptors: *Nutrients, *Hogs, *Farm wastes, *Waste treatment, Oxidation lagoons, Confinement pens, Odor, Aerobic treatment,
Identifiers: Oxidation ditch mixed liquor (ODML)

The magnitude of swine excreta production in large confinement operations presents the potential for liquid, solid and gaseous pollution. Aerobic treatment of the excreta with a system like an oxidation ditch minimizes the opportunity for odor problems. The nutritive value of fresh excreta is enhanced by the oxidation ditch's aerobic microbiota which digest the excreta and assemble single cell protein. It has been found that adding oxidation ditch mixed liquid to a diet marginal in amino acids improves the performance of finishing swine. Utilization of this liquid product provides a source of water and nutrients for swine, while minimizing any chance of liquid or solid pollution, (Cartmell-East Central).

### 1796-A8,B3,C2,C3,E1,E2
### SLUDGE DISPOSAL: A CASE OF ALTERNATIVES
Water Pollution Control Federation Manforce.
Deeds and Data, December, 1971, p. D-1—D-4.

Descriptors: *Sludge disposal, *Waste treatment, *Waste disposal, Fertilizers, Irrigation, Soils, Incineration, Lagoons.
Identifiers: *Alternatives, Land disposal, Ocean disposal.

A panel discussed alternatives for sludge disposal. Some treatment plants can transport sludge to crop lands. Guidelines can be written for heated anaerobically digested sludge to be applied at rates up to 100 dry tons/acres for any soil type. Cadmium, lead, mercury, copper and chromium in the sludge do not appear to be detrimental to crops. There are also extremely few pathogen problems. Cities like New York, however, don't have available land to dispose of effluent. Other disposal methods are incineration, ocean disposal, and lagooning. Very little survey work cost data has been published on various methods of sludge disposal. It is obvious that much more experimentation and research is needed in order to solve the sludge disposal problem. (Wetherill-East Central)

### 1797-B1, D3, E3
### WASTE PROCESSING PLANT IS PLANNED AT UNITED BEEF
*Beef*, Vol. 11, No. 2, p. 13, October, 1974.

Descriptors: *Farm wastes, *Waste disposal, *Cattle, *Feeds, Feed lots, Fertilizers.
Identifiers: Waste processing, Aerobic digestion, United Beef Producers.

The Searle Agriculture, Inc. has started construction of an animal waste processing plant on the United Beef Producers feedlot. The process, aerobic digestion, results in a product that has use as a soil conditioner, potting soil base, or possibly a base for a nitrogen fortified fertilizer. It also has the potential as a feed ingredient for cattle. Samuel Huttenbauer, Jr., President of U.B.P., stated the plant will give a means of waste disposal to improve the sanitation program and an opportunity to participate in developing a feed ingredient for cattle feeding industry. (Cameron-East Central).

### 1798-A5, A6, B2, B5, D3
### EVALUATION OF ANAEROBIC LAGOON TREATING SWINE WASTES
Sanitary Engineering Department
Mississippi State University
State College
A. Shindala and J. H. Scarbrough
Transactions of the ASAE, p. 1150-1152, 1972. 4 fig, 2 tab, 3 ref.

Descriptors: *Lagoons, *Anaerobic conditions, *Waste treatment, *Farm wastes, *Hogs, Odor, Waste disposal, Water pollution,

The effectiveness of a single cell anaerobic lagoon in the treatment of swine wastes was investigated. Compiled data revealed that anaerobic lagoons would provide considerable reduction in the pollutional characteristics of animal wastes. The effluent, however, was still offensive and required further treatment prior to discharge. (Marquard-East Central).

### 1799-B1, F1, F2
### FARM POLLUTION: HOW REGULATIONS AFFECT YOU
Successful Farming, Vol. 72, No. 8, p. 30; June-July, 1974.

Descriptors: *Permits, *Regulation, *Livestock, *Farm wastes, Waste storage, Waste disposal, Cost sharing.
Identifiers: *Laws, Farm pollution.

Several states now administer Federal discharge permits. Only one permit is needed which covers both state and Federal regulations. But in most states, you need two permits—both state and Federal. All livestock facilities, which have a waste discharge and which hold for 30 days the following number of animals, must apply for a permit: slaughter and feeder cattle—1,000; mature dairy cattle—700; all swine over 55 lbs.—2,500. Livestock confinement facilities include open feedlots, confined feeding operations, stockyards, livestock auction barns and buying stations. Non-point source regulations are gaining consideration. Information and instructions on how to apply for permits and where to get cost-sharing help is given. (Cameron-East Central).

### 1800-A8, E2
### EFFECTS OF CONTINUOUS (ZEA MAYS L.), MANURING, AND NITROGEN FERTILIZATION ON YIELD AND PROTEIN CONTENT OF THE GRAIN AND ON THE SOIL NITROGEN CONTENT
Department of Agronomy
Nebraska University
Lincoln
F. N. Anderson and G. A. Peterson
Agronomy Journal, Vol. 65, No. 5, p. 697-700, September-October, 1973. 4 fig, 4 tab, 9 ref.

Descriptors: *Corn, *Nitrogen, *Fertilizers, *Proteins, *Soils, Nitrogen depletion
Identifiers: *Manuring, *Yield

The specific objective of this paper was to report the cumulative effects of 60 years of continuous corn on yield and protein content of the grain and the nitrogen supplying capacity of the soil. It was concluded from the data that manuring is a valuable practice in maintaining soil productivity. It was shown that nitrogen fertilization alone was capable of restoring most of the production capacity of the soil. Initiation of nitrogen fertilization resulted in a much more rapid recovery of yield than did the initiation of manuring. Protein levels in the corn grain were consistently highest on manured treatments at all but the 180 kg/ha nitrogen fertilizer rate. Cultivation without manuring or nitrogen fertilization decreased the soil nitrogen content forty percent after 30 years of continuous corn production. Manuring from 1941 to 1972 increased the total soil content to 90 percent of the level present in the soil in its native condition. (Cartmell-East Central).

### 1801-A6, A10, B3, C1, D3
### ENVIRONMENTAL CONDITIONS AFFECTING DEVELOPMENT OF HOUSE FLY LARVAE IN POULTRY MANURE
Department of Avian Science
Colorado State University
Fort Collins
J. S. Teotia and B. F. Miller.
Environmental Entomology, Vol. 2, No. 3, p. 329-333, June, 1973. 3 fig, 7 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Larvae, *Biodegradation, Temperature, Moisture content, Odor.
Identifiers: *Development, *Manure, *House fly larvae, Pupae.

The studies reported here were to determine the optimum conditions for house fly larvae to biodegrade poultry manure. Fly eggs were collected, separated from manure, weighed and inoculated in the fresh poultry manure in plastic tubs (14 x 12 x 5-inch deep) daily. Inoculation rates varied frim 2 to 5 g of eggs per 4 kg of poultry manure. These tubs were stored at different temperatures (22 degrees-38 degrees Centigrade) and RH conditions (19-80 percent) in a modified chick incubator. Optimum yield of dry pupae (weight) was obtained with a combination of 3 g of fly eggs in 4 kg of fresh manure at 27 degrees Centigrade and 41 percent RH. As the quantity of fly eggs per gram of poultry manure was increased, the yield of pupae was depressed. The environmental humidity had a profound effect on the yield of pupae. When the RH of the digestion chamber was increased from 38 to 70 percent the yield of pupae at temperatures of 34 degrees—38 degrees Centigrade was increased significantly. Approximately 8 days were required for the fly eggs to be converted to pupae in the fresh poultry manure at 27 degrees Centigrade and 41 percent RH. Fly eggs can be used to digest the manure under caged birds. The odor of digested manure is reduced. The moisture content of the digested manure varied from 50.0 to 67.5 percent, whereas the moisture content of undigested manure was 80 percent. (Cartmell-East Central)

### 1802-A2, A6, B2, B4, D3, E2, F1
### ENVIRONMENTAL, ECONOMIC, AND PHYSICAL CONSIDERATIONS IN LIQUID HANDLING OF DAIRY CATTLE MANURE
G. L. Casler and E. L. LaDue
New York's Food and Life Sciences Bulletin (Social Sciences: Agricultural Economics, No. 1), No. 20, 23 p. October, 1972. 10 tab, 42 ref.

Descriptors: *Dairy industry, *Cattle, *Farm wastes, *Waste storage, *Waste treatment, Waste disposal, *Liquid wastes, Odor, Runoff, Economics, Nutrients, Costs, Storage tanks, Oxidation lagoons.
Identifiers: Land spreading, Slatted floors, Open pits.

The environmental, economic, and physical implications of liquid manure handling for dairy cattle is considered. It was found that six months storage of liquid manure for disposal in the spring is not always beneficial. Large quantities of manure spread in the spring just before heavy rain may cause more stream pollution than small quantities spread daily during the winter. Also, odor is more offensive in the spring. An investment of $27,000-$37,000 would be required for a 100-cow liquid manure system with a six month storage capacity. Labor savings and increased manure value offset only a small part of the annual costs of a liquid manure system. The total return to the farm operator will rarely offset the costs incurred. Even if all costs and benefits could be internalized to the farm level costs would usually exceed benefits. (Ballard-East Central).

### 1803-A11, B3, E3
### FEEDLOT ANIMAL WASTE COMPARED WITH COTTONSEED MEAL AS A SUPPLEMENT FOR PREGNANT RANGE COWS
Agricultural Engineering Department
California University
Davis
J. L. Hull and J. B. Dobie
Presented at 1973 Winter Meeting, American Society of Agricultural Engineering, Chicago, Illinois, December 11-14, 1973, Paper No. 73-4506, 12 p. 3 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Feed lots, *Feeds, *Cattle, *Barley, *Waste disposal, Performance.
Identifiers: *Animal wastes, Cottonseed meal, *Supplement.

Three groups of pregnant cows grazing dry native range were supplemented with cottonseed meal, a mixture of 75 percent feedlot manure and 25 percent barley, or received no supplementation. This experiment lasted 84 days and was designed to give some insight into the possibility of feeding animal waste as an alternative to customary waste disposal procedures. Cows fed the manure-barley supplement consumed more feed than those fed the cottonseed meal supplement, but they also had a higher body weight. The individual cow variations in consumption of the manure-barley supplement were similar to those fed cottonseed meal supplement. This experiment shows that manure in combination with barley may be fed as a supplement to pregnant range cows. This provides an alternative to the use of high protein supplements. Using waste as a range supplement provides a means of recycling the nutrients contained in the waste and a method for waste disposal. (Russell-East Central).

## 1804-B1, B4, E2, F1

### FEEDLOT DESIGN AND CONSTRUCTION

D. Gill and M. D. Paine
Feedlot Management, 1973 Cattle Feeder's Planner, Vol, 14, No. 12, p. 34-36, 84 November, 1972. 1 fig.

Descriptors: *Feed lots, *Farm wastes, *Construction, *Design, Cattle, Costs, Waste storage, Waste disposal.
Identifiers: *Facilities, Equipment, Land disposal.

Feedlots should be constructed on a well drained site suitable for expansion. The center of the feedlot should be on the highest ground with 4-10 percent slopes away from it. The amount of land for the site, making allowances for facilities and for expansion of feedlot, should be about 1.4 acres per 100 head or 12 acres per 1,000 head. Adequate land for stockpiling waste should be available. To control runoff, a detention pond system should be used. Arrangement of facilities upon the site should be carefully considered. These facilities are (1) receiving and loading facilities, (2) pens, (3) alleys, (4) fencing, (5) water facilities, (6) windbreaks and shades as required and (7) feeding facilities. The size and location of these facilities is determined by herd size. Proper design of feedlots can reduce travel distances by approximately 25 percent compared to unplanned layouts. As a result, annual operating costs can be reduced by 6-10 percent. A modern feedlot must be designed to do an efficient job of feeding cattle, however, investment costs must be in line with the income potentials of cattle feeding. (Cameron-East Central).

## 1805-A1, A7, B2, B3, D2, D3, E1, E2, E3, F3

### FEEDLOT WASTE MANAGEMENT SYSTEMS

R. C. Albin
Proceedings of the 1970 Beef Cattle Conference. Texas Tech University Animal Science Department, Lubbock, and Texas Tech University Research Center, Pantex, October 29, 1970, p. 8-17. 26 ref.

Descriptors: *Farm wastes, *Feed lots, Pollutants, Waste treatment, Waste disposal, Runoff, Aerobic conditions, Anaerobic conditions, Lagoons, Dehydration, Incineration, Recycling.
Identifiers: *Waste management systems, Land spreading, Composting.

The rapid expansion of cattle feedlots in the U. S. created the problem of handling and disposing of a vast quantity of feedlot wastes. The chemical and pollutional characteristics of feedlot wastes vary. The type of ration, size of cattle, climate, feedlot surface, and moisture content are all important factors in developing a waste management system. Numerous handling and disposal systems such as anaerobic and aerobic systems, lagoons, composting, oxidation ditches, dehydration, incineration, and nutrient recycling are available. However, final disposal of feedlot waste has been on land in most instances. The Great Plains Agricultural Council report recommended that research efforts be intensified in the areas of air pollution, land disposal, pollution under feedyards, systems analysis, complete economic evaluation of current alternatives for waste disposal, and socio-legal implication. (Dudley-East Central).

## 1806-A8,B3,C2,C3,D3,E2

### FEEDLOT MANURE, A POTENTIALLY VALUABLE MATERIAL

Compost Corporation
Canyon, Texas
F. Sims
Compost Science, Vol. 14, No. 4, p. 24-25, July-August, 1973.

Descriptors: *Feed lots, *Farm wastes, *Waste treatment, *Waste disposal, Carbon, Fermentation, Costs, Texas, Crop production, Yields, Fertilizers.
Identifiers: *Manure, Toxic fermentation, Composting, Land spreading.

After reviewing other methods of feedlot waste disposal and/or reuse, Fletcher Sims turns to composting as perhaps the best alternative for waste handling. He quotes Dr. William Albrecht as saying that there is only enough carbon in the world to support 8,000 pounds of vegetation per land surface area. Thus this carbonaceous material should not be wasted. Fermentation or composting of feedlot wastes can mean vast improvement for poorly treated land and can serve as an alternative in feedlot waste handling problems. The main problem in composting is pathogens. Mr. Sims controls these by attaining a 140 degree temperature in treating the material. A Howard Rotovator is used in sizing and mixing the material. An inexpensive 600-ton-per-hour turning machine is used for spreading the material. Improved yields and improved nutrient balance may be attained through use of such composts on crop lands. (Cameron-East Central).

## 1807-A6,A11,B1,E2,F1

### CONFINEMENT PAYS — IF WEATHER IS BAD!

Beef, p. 38-39, March, 1972.

Descriptors: *Confinement pens, *Costs, *Weather, Odor, Feed lots, Performance, Winter, Missouri, Waste storage, Waste disposal.
Identifiers: Waste handling, Manure, Land spreading.

At a Missouri Cattle Feeders Seminar, four speakers concluded that a confinement system will pay in a bad winter, but it's pretty marginal in a mild winter. Flint McRoberts felt that many factors determine whether a confinement barn is a sound investment. Among the factors were costs, stocking rates, outdoor lot conditions, time of year cattle are finished, number of cattle and adjoining pastures. Problems he mentioned were odors, manure handling, and flies. McRoberts listed alternate possibilities to confinement barns. Three University of Missouri experts compared open lots and confinemet barns on cost, performance of cattle, and profitability. Neil F, Meador found the entire bill for a near-500 head operation to be $76,050 or $106 per head, allowing 20 square feet per animal. A. J. Dyer found that in a bad winter, the cattle in confinement gained faster. During a mild winter, the cattle in the outside lots gained slightly faster. Myron Bennett concluded that clearly, the barn would pay in a bad winter—but not in a mild one. (Cameron-East Central)

## 1808-B1, D3, E3

### MONFORT FUELS FEEDLOT AND PLANT WITH MANURE

Calf News, Vol. 12, No. 6, p. 12, June, 1974. 1 fig.

Descriptors: *Fuels, *Methane, *Farm wastes, *Waste treatment, Runoff. Natural gas, Feed lots, Anaerobic digestion, Costs, Odor, Fertilizers, Air pollution, Water pollution, Cattle.
Identifiers: Manure, Waste handling.

Monfort of Colorado, Inc., Greeley, has granted an option to Shelley B. Don and Associates of Denver for construction of a facility to produce four million cubic feet of methane gas per day from manure. The process also reduces the odor associated with manure handling while enhancing the value of the residue as a fertilizer. An anaerobic digestion process would be utilized in the methane production within a closed or covered system which will not generate air or water pollution. There will be no water runoff from the process. Estimates on the cost of producing a thousand cubic feet of pipeline quality gas from a large efficient plant range from a low of 60 cents to three dollars. Conservative estimates place the yield of gas that can be produced from the manure of one animal on feed at 40 cubic feet per day. (Cameron-East Central).

## 1809-A6, B2, D3, E3, F1

### MANURE REFEEDING CUTS ODOR, SOLVES DISPOSAL PROBLEMS FOR THIS HOGMAN

B. Coffman
Farm Journal, Vol. 98, No, 10, p. H-6, November, 1974. 1 fig.

Descriptors: *Electricity, *Waste disposal, Hogs, Odor, Slurries.
Identifiers: *Manure, Oxidation ditch, *Paddlewheels, *Refeeding.

Instead of hauling hog manure, Paul Smart, Douglas County, Kansas, uses more than 3 dozen paddlewheels churning round the clock in oxidation ditches in 11 buildings. He buys about $13,000 of electricity annually to run the entire complex. In a 500 ft. long building completed this summer, Smart installed 12 custom-made paddlewheels, and is experimentally refeeding the oxidation ditch slurry in two pens. To refeed liquid manure, Smart's farm manager fashioned a 40 ft. long rectangular steel tubing (3" x 5") into a trough long enough to serve 2 pens. Liquid is lifted from the oxidation ditch by the paddlewheel as it churns at 100 rpm. The liquid flows through the trough by gravity—running continuously. Smart hasn't hauled manure in eight years, and he is marketing 13,000 to 15,000 head a year. (Cameron-East Central).

## 1810-A9, A10, B1, E2

### NO CHANGES IN FLY CONTROL FOR 1974

W. L. Gojmerac
Hoard's Dairyman, Vol. 119, No. 10, p. 674-675, May 25 1974. 1 fig.

Descriptors: *Pest control, *Dairy industry, *Farm wastes, Waste treatment, Waste disposal, Organic wastes.
Identifiers: *Fly control, Manure, Sanitation, Insecticides, Decaying, Land spreading.

The basis of fly control or pest management is to consider the total environment and, by one of several different means, use management techniques which keep pests at a low or reasonable level. In the summer, all essential ingredients for fly production are present on a dairy farm. Maggots need decaying organic matter to live. It can be manure, wet hay or straw found under and around feed bunks, or even lawn clippings on a compost pile near the house. Sanitation used in reference to fly control refers to locating and removing decaying organic matter, such as cleaning calf pens and feed alleys regularly. Farmers can either remove the manure and stack it away from the buildings or spread it on a field if one is available. Insecticides can also be used by dairymen. Because of anticipated shortages and/or higher prices of insecticides in 1974, sanitation may be relied upon more. (Cameron-East Central)

## 1811-A2,B2,B4,D3,E1,E2

### AVERT RUNOFF POLLUTION

W. Waltner and E. Waltner
Feedlot Management, Vol. 15, No. 5, p. 35-36, May, 1973. 3 fig.

Descriptors: *Runoff, *Feed lots, *Farm wastes, *Irrigation, *Evaporation, *Playas, *Lagoons, *Waste storage, *Waste disposal.
Identifiers: *Pollution, Pump-out system, Drainage, Dams, Land disposal.

Various evaporation and irrigation systems are used to prevent runoff pollution. Several specific feedlots and their runoff control measures are cited for feeders located in the Southwest. Some feedlot owners direct their feedlot runoff into playas. Others construct lagoons to catch the runoff and to provide a means of irrigation of adjoining land. Others use septic tanks to store the runoff water. The water is then pumped to irrigate adjoining fields. An Oklahoman constructed 2 storage ponds for consecutive storage of the wastewater and ultimate evaporation when it is pumped into shallow evaporation pans. Solids are removed to a storage area for composting. These and other systems constructed to meet individual feedlot problems show that while big feedlots in the southwestern states are comparatively "young," they are mature in grappling with pollution runoff control. (Cameron-East Central).

## 1812-A11, B1, B5

### FEEDING VARIATIONS CAN AFFECT WASTE

Feedlot Management, Vol, 15, No. 8, p. 22, August, 1973.

Descriptors: *Farm wastes, *Feed lots, Confinement pens, Texas, Cattle, Slopes.
Identifiers: *Waste accumulation, Roughage, Shade.

Three experiments were conducted to determine the effects of environmental factors upon feedlot waste accumulation. Results showed that neither shaded or unshaded pens nor slope of feedlot surface affected the amount of wastes produced. Rations with no roughage were fed and yielded 2.2 lbs. of waste per day. Ten percent roughage ration yielded 4.5 lbs. per day and 12 percent roughage yielded 5 lbs. of waste per day. A decrease of 12 percent to 8 percent roughage would significantly decrease the amount of waste accumulation without affecting animal performance. (Frantz-East Central).

## 1813-A2,A8,B2,B5,C2,D1,E2

### EXPERIENCE WITH A SPRAY-RUNOFF SYSTEM FOR TREATING BEEF CATTLE FEEDLOT RUNOFF

Agricultural Engineering Department
Kansas State University
Manhattan
D. E. Eisenhauer, R. I. Lipper and H. L, Manges
Presented at 1973 Mid-Central Meeting, American Society of Agricultural Engineers, St. Joseph, Missouri, April 6-7, 1973, Paper No. MC-73-302, 22 p. 2 fig, 11 tab, 6 ref.

Descriptors: *Waste treatment, *Cattle, *Feed lots, *Runoff, Biochemical oxygen demand, Nitrogen, Salinity, Alkalinity, Soil profile.
Identifiers: *Spray-runoff system, *Pollution.

An experimental study was conducted to examine the spray-runoff technique as a possible alternative to disposal practices of beef cattle feedlot runoff. A detailed discussion of the construction of the system and test results are given. While treatment of the feedlot runoff by using the spray-runoff system did occur, a satisfactory effluent for direct release to the environment was not produced. Concentration reductions of BOD5 and Kjeldahl nitrogen were from 40-60 percent under the most favorable conditions. Mass reductions of BOD$_5$ and Kjeldahl nitrogen were as high as 90 percent. Accumulations of salt, sodium and potassium were found in the soil profile after 29 inches of the wastewater had been applied but no serious saline or alkali hazards had developed. (Dudley-East Central).

## 1814-A4, A5, A7, B1, E2, F2

### FEEDLOT POLLUTION

Public Health Engineer, Chief, Water Pollution Control Section, Division of Environmental Sanitation, Montana State Department of Health, Helena
D. G. Willems
Montana Agriculture—Focus on Improving the Environment, Annual Agricultural Seminar, Great Falls, Montana, December 3-4, 1970, p. 31-34.

Descriptors: *Feed lots, *Air pollution, *Water pollution, *Montana, *Regulation, *Legal aspects, *Permits, Waste disposal.
Identifiers: *Point source wastes, Land disposal.

The Montana water pollution control law prior to 1970 is delinated. Its greatest effect was upon industry and municipalities because their point source wastes were easy to identify and treat. But agricultural pollution must be met as well. Confined animal feeding drainage may well be the largest point source discharge in terms of organic material. The purpose of the proposed 1970 confined animal feeding regulation is: (1) to see that feedlot operations are properly located with respect to municipalities and residential areas, and (2) to control air and water pollution problems. The regulation would require new feedlots and expanding feedlots to secure a permit from the Department of Health as soon as the regulation is adopted. (Hisle-East Central).

## 1815-B3, B5, C2, D1, F6

### ELECTRICALLY MANAGING WASTE FROM CAGED LAYERS

Agricultural Engineering Department
Georgia University
Athens
J. M. Allison and G. R. Bishop.
Presented at 66th Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, 12 p. Paper No. 73-347, 5 fig, 4 tab, 5 ref.

Descriptors: *Farm wastes, *Management, *Poultry, *Ventilation, *Chemical properties, *Model studies, Moisture content, Biodegradation.
Identifiers: *Electric heat, *Moisture removal, *Deep-pits.

A model study was set up to study different methods of removing moisture from caged-layer wastes and to study changes in chemical composition of poultry manure under various drying conditions. Natural ventilation and 100 FPM were chosen for air movement for four various treatments. In all treatments the manure dried uniformly with forced air ventilation; little drying occurred in the control (no heat) and in the toe-drained treatments. The possibility was indicated for well distributed forced air ventilation to remove nearly as much moisture from caged-layer waste as from forced ventilation with electrical underheat. Chemical analyses of dried wastes are included. (Frantz-East Central).

## 1816-A11, B1, B4

### THREE DAIRYMEN REPORT HOW SLATTED FLOORS HAVE WORKED FOR THEM

D. W. Bates
Hoard's Dairyman, Vol. 119, No. 6, p. 394-395, March 25, 1974. 3 fig.

Descriptors: *Dairy industry, *Cattle, *Breeding, Minnesota, Waste storage, Farm wastes.
Identifiers: *Slatted floors, Heat detection, Barns

Slatted-floor barns with manure storage beneath have proved to be highly successful. This is a report on three such barns on Minnesota dairy farms, All have slatted floors with manure storage beneath; heavily insulated walls and flat, insulated ceilings; and mechanical ventilation, Landsverk Barn: The stall unit is 26 feet by 130 feet and the slatted section is 40 feet by 28 feet with a total of 120 free stalls for 130 cows. The manure tank has a capacity for about four months. Heat detection is much easier. Breeding problems are fewer. Euerle Barn: This barn has a self-emptying manure pit. The barn is 39 by 148 feet and houses 80 cows. There are 84 free stalls. The stalls are carpeted and no bedding is used. Heat detection is harder. There have been no breeding problems. Glawe Barn: The barn is 48 by 244 feet. There are 94 free stalls, 2 maternity pens, and 2 additional pens in the center of the barn. The manure tank provides storage for about 11 months. Rubber mats are set in the stalls and no bedding is used. Heat detection is easier and breeding repeats have been a problem. (Cartmell-East Central).

## 1817-A6, B2, D1, E2, F1

### FLUSH SYSTEM CUTS CONFINEMENT COSTS

Beef, p. 12-15, February, 1973.

Descriptors: *Confinement pens, *Cattle, *Farm waste, *Costs, Waste treatment, Waste storage, Waste disposal, Nebraska, Lagoons, Anaerobic conditions, Odor.
Identifiers: *Flush system, Land disposal, Slatted floors.

A confinement feeding system has been developed which cuts costs from $100 per head to $69 per head. Above floor level is a semi-open building 510 feet long with closed north walls and an open south wall. Sliding doors along the north wall provide summer cooling. The building is divided into six pens which allow 19 square feet of pen space for each 1,000 lbs. of body weight. The building has a capacity of 1,050 head. On floor level, less than one half of the area is slatted. Outside aprons plus center islands are solid and sloped toward two slatted areas. These slats cover pits that are two feet deep. Wastes collected in these pits are flushed every two days into an anaerobic lagoon. These wastes are then applied to field crops. Problems have been odors and manure buildup on the gutters. Odor was overcome after the lagoon stabilized. Manure buildup was prevented by a wooden sled placed into the gutter. Water pressure drives it along to scrape the manure into the lagoon. (Marquard-East Central),

## 1818-B2, B4, D1, D3, E2, F1

### BUDGET-PRICED CONFINEMENT?

Beef, Vol. 9, No. 9, p. 34-35, May, 1973. 2 fig.

Descriptors: *Confinement pens, *Costs, *Economics, *Cattle, *Farm wastes, *Management, Waste treatment, Waste storage, Waste disposal, Lagoons, Feed lots.
Identifiers: Land disposal, Slatted floor.

Two feedlot operator brainstorming sessions have resulted in untried plans for a confinement feeding system that cuts costs in half. The system uses a reduced slatted section running full length of the building instead of large gutters underneath, a much smaller flume arrangement is used. The wastes then run into an aerated lagoon. To control odors and winter freezing, warm air is pumped into the lagoon by three thirty horsepower motors. Land application is then used for final disposal. The cost of such a confinement unit will be under $70 a head. (Marquard-East Central).

## 1819-B1, E3

### GE ENTERS MANURE RECYCLING RACE

Calf News, Vol. 10, No. 4, p. 1, April, 1972, 2 fig.

Descriptors: *Farm wastes, *Feed lots, *Recycling, *Feeds, Proteins, Waste treatment, Waste disposal.
Identifiers: General Electric.

General Electric has committed one million dollars as a starter on a pilot plant that basically converts 2,000 pounds of farm wastes into 700 pounds of 60% protein feed supplement. The remainder of the matter is disposed in the form of carbon dioxide and hydrogen. How to market the process to the feed lots is undecided. (Frantz-East Central).

### 1820-A2, B2, D3, E2

### GRASS-FILTER SYSTEMS . . . ANOTHER NEW RUNOFF CONTROL METHOD

Feedlot Management, Vol. 15, No. 5, p. 42, May, 1973.

Descriptors: *Waste treatment, *Waste disposal, *Runoff, *Control, *Farm wastes, *Fescues, Aerobic conditions, Lagoons, Feed lots, Kansas, Nutrients.
Identifiers: *Grass filter systems.

A fescue grass-filter system for absorbing and treating runoff is being tested at the 20,000 head Blackjack Feedyards, Inc., near Yates Center, Kansas, The system is based on fescue grass over which lagoon-collected runoff is sprayed irrigation-style. A buildup of soil bacteria which forms a mat on the ground digests the feedlot waste solids purifying the runoff. Mat depth must be kept at less than 1 inch at all times or the system will become anaerobic. Grass is necessary to hold the solids on the land so that the bacteria can multiply and digest the material. Fescue grass is a good choice for eastern Kansas because of its adaptability to heavy moisture. If winter icing problems and year round mat buildup can be combatted effectively, it is hoped that grass-filter systems will be an acceptable method of treating and disposing of runoff. (Cartmell-East Central).

### 1821-A2, A8, B2, E2

### IRRIGATION OF PERENNIAL FORAGE CROPS WITH FEEDLOT RUNOFF

Agricultural Research Service
United States Department of Agriculture
Lincoln, Nebraska
N. P. Swanson, C. L. Linderman and J. R. Ellis.
Transactions of the ASAE, Vol. 17, No. 1, p. 144-147, January-February, 1974, 4 tab, 6 ref.

Descriptors: *Irrigation, *Runoff, *Feed lots, Forage grasses, *Waste disposal, Farm wastes, Cattle, Nebraska, Salts, Nutrients.

A study was conducted during 3 growing seasons, July 1, 1970 to October 1, 1972 on a silty clay loam soil. A maximum of 90 inches of runoff was applied to plots of perennial ryegrass, tall fescues, and Ladino clover. Accumulations of salt and nutrients found in the soil were not enough to be harmful. Although the effluent and 62.93 inches of precipitation exceeded the crops' water requirements, forage yields generally improved. There were no toxic contents in the forage which was of excellent quality. During the second season Ladino clover, a salt-sensitive crop, dominated the stands. It was indicated that undiluted runoff can be safely used to irrigate crops of low salt tolerance. (Frantz-East Central).

### 1822-A11, B2, D3, E3, F1

### KISSINGER'S CASE FOR CONFINEMENT

R. Sanders
Successful Farming, Vol. 71, No. 12, p. B1-B3, November-December, 1973, 4 fig.

Descriptors: *Confinement pens, *Farm wastes, *Cattle, Lagoons, Costs, Waste storage.
Identifiers: Slatted floor, Carcass improvement, Modified gutter flush building.

A Nebraska farmer-feeder moved into a new 1,050-head beef confinement building. It is a modified gutter flush building with a lagoon. Only a third of the floor is slatted. That is over a shallow flush pit which is flushed clean from water recycled from the deep lagoon. The design saves about $30 a head in construction costs and eliminates manure handling. It also yields a 1 percent improvement in hot carcass. One of the problems is the tendency of manure to stick to the rough sides of the pit. A wooden sled scraper pushed by water flow was developed to combat this problem. (Cartmell-East Central).

### 1823-A9, A10, A12, B1, B5

### GARDONA AS A FEED ADDITIVE FOR CONTROL OF FLY LARVAE IN COW MANURE

Animal Husbandry Research Division
Agricultural Research Service
United States Department of Agriculture
Beltsville, Maryland
R. W. Miller, C. H. Gordon, M. C. Bowman, M. Beroza and N. O, Morgan.
Journal of Economic Entomology, Vol. 63, No. 5, p. 1420-1423, October, 1970, 3 tab, 10 ref.

Descriptors: *Feeds, *Additives, *Farm wastes, *Cattle, *Larvae, *Larvicides, Mortality, Dairy industry.
Identifiers: *Gardona, *Manure, Flies, Residues.

Four lactating dairy cows were fed 4 levels of Gardona, a larvicide, for 7 days. At levels of 22, 37, and 48 ppm. of the air-dry ration, Gardona killed 94 percent or more larvae of the house fly (Musca domestica) seeded onto the feces. The larval mortalities in the manure increased as the levels of Gardona in the ration was increased. But, after day 8, following the Gardona-ration feeding, larval mortalities began to decrease. In the first 2 trials almost no Gardona appeared in the cows' milk, but some milk samples from the 3rd trial contained Gardona residues. (Frantz-East Central).

### 1824-A11, B3, E1

### THE REUSE OF BROILER LITTER WITH "LITTER LIFE" — ITS EFFECT ON PERFORMANCE

Poultry Research Associate
Delaware University
G. W. Chaloupka
Presented at Proceedings of the 1969 National Poultry Litter and Waste Management Seminar, Salisbury, Maryland, September 20-30, 1969, p. 41-49, 5 tab.

Descriptors: *Poultry, *Litter, *Performance, *Additives, Recycling, Economics, Costs, Diseases, Waste treatment.
Identifiers: *Litter Life, *Broilers.

In the past few years, the reuse of litter has become a common practice in most poultry operations. Complete clean out now takes place less often and in some cases not until a disease problem occurs. Research was conducted using the mineralized litter additive "Litter-Life" to see if broilers would perform as well on reused litter as on new litter. Two substation houses were used and "Litter Life" was added at a prescribed rate in one. When results were tabulated, it was found that birds grown on composted litter (with Litter Life) did not show a reduction in percent condemned as did the other house. However, one has to wonder whether management, such as light intensity and ventiliation has any effect on condemnation results. When expenses were compared, it was found that using new litter resulted in about $ .0030 more production cost per pound of broiler produced. Final results indicated that there is little doubt that reused litter can be used very satisfactorily in producing broilers whose performance surpasses that of those grown on new litter. (Russell-East Central).

### 1825-B1, C2, E2

### AREA NEEDED FOR LAND DISPOSAL OF BEEF AND SWINE WASTES

Specialist, North-Central Regional Extension Project
Iowa State University
Ames
D. H. Vanderholm
Cooperative Extension Service Publication Pm-552 Iowa State University, Ames, January, 1973, 2 p. 4 tab.

Descriptors: *Farm wastes, *Cattle, *Hogs, *Waste disposal, *Nitrogen, Phosphorus, Potassium, Formulation, Irrigation.
Identifiers: *Land disposal, *Pollution.

Formulas were established to determine the areas required for land disposal of hog and cattle wastes. The formulas are based upon an estimated 120 pounds nitrogen excreted per 1000 pound-cow and 18.25 pounds per 100 pound-hog, varying with ration, breed, and size of the animal. Nitrogen losses in treatment, storage, and handling have been established for six types of management systems to arrive at recommended disposal areas based upon 100 pound Nitrogen applications per acre. Corresponding P and K rates are given. Approximate nutrient content of various farm waste forms are given. (Frantz-East Central).

### 1826-A6, A7, C2

### ATMOSPHERIC COMPOSITION IN AN ENCLOSED SWINE PRODUCTION BUILDING

J. A. Merkel
PhD Thesis, Agricultural Engineering Department, Iowa State University, 1968, 115 p. 23 fig, 3 tab, 63 ref.

Descriptors: *Hogs, *Confinement pens, *Farm wastes, *Chromatography, *Gases, *Atmosphere, Odor, Volatility, Sulfur compounds, Carbonates, Nitrogen compounds, Decomposing organic matter, Solubility, Equipment, Air pollution, Iowa.
Identifiers: *Atmospheric composition, *Enclosed swine production building.

A study was conducted to determine the gases present in a confined hog production system, other than those gaseous elements known to compose normal air. Volatile gases were collected from liquid manure samples in the AKSI-ISU Swine Atmosphere Research Laboratory. Positive identification of the gases was accomplished by established chromatographic components coupled with homologous plots and retention data. Volatile sulfur compounds identified included mercaptans, sulfides, and disulfates. Volatile nitrogen compounds were amines and amides. Volatile carbon compounds identified were methanol, ethanol, n-propanol, iso-propanol, n-butanol, iso-butanol, iso-penethol, formaldelhyde, acetaldehyde, propianaldehyde, isobutraldehyde, valeraldehyde, heptaldehyde, octaldehyde, and decaldehyde. Amines, mercaptains, sulfides, and disulfides resulting from the breakdown of amino-acids were believed to compose most of the objectional odors from decomposing wastes. (Frantz-East Central).

### 1827-A6, A10, B3, D1

### THIN-BED DRYING OF POULTRY MANURE

Extension Agricultural Engineer
California University
Riverside
W. C. Fairbank and F. C. Price
Poultry Digest, Vol. 33, No. 388, p. 238-240, 3 fig.

Descriptors: *Farm wastes, *Drying, *Poultry, California, Odor, Aerobic conditions, Larvae, Waste treatment, Waste disposal, Fertilizers.
Identifiers: *Manure, Fly control, Land disposal, Composting.

California poultrymen have developed or adapted a number of schemes for the rapid natural drying of cage-house poultry manure. The primary objective is to reduce moisture content sufficiently to prevent development of fly larvae. On many ranches, this natural drying of manure has resulted in a high level of fly control during most of the year. Secondary benefits are the conversion of heavy, sticky, repulsive by-product to an easy-to-handle "fertilizer," and the prevention of further noxious odors by maintaining an aerobic condition. Thin-bed drying can be adapted to either solid or liquid manure collection systems. Thin-bed drying is basically a dry-season process that has limited use during wet weather. Fly control by thin-bed drying may require cleanout within one to seven days after the manure is dropped, depending on the season and the rate of natural drying. All of the manure-drying schemes, methods, and variations fall into the broad categories: (1) Manure spreader (solid or liquid); (2) Shallow bed with daily stirring; (3) Tiller drying. These are discussed in detail. (Cartmell-East Central).

## 1828-A11, A12, B3, B5, D2

### THE INFLUENCE OF TEMPERATURE AND MOISTURE ON THE DISINFECTING ACTIVITY OF METHYL BROMIDE ON INFECTED POULTRY LITTER

Houghton Poultry Research Station, Houghton
Huntingdon, England
E. G. Harry, W. B. Brown and G. Goodship
Journal of Applied Bacteriology, Vol. 36, No. 2, p. 343-350, June, 1973.

Descriptors: *Temperature, *Moisture content, *Farm wastes, *Poultry, *Waste treatment, *Disinfection, *Litter, Samonella.
Identifiers: *Methyl bromide.

The object of the present investigation was to determine the effect of moisture and temperature on the disinfecting activity of MeBr gas and to indicate the gas concentrations likely to be required to disinfect materials such as poultry house litter. The disinfecting activity of MeBr is related not only to the level of exposure to the gas, but also to the moisture content of the material exposed. The activity was also reduced at a reduced temperature. At 25 degrees, exposure to MeBr at a CT product of 800 mg h/1 was sufficient to prevent recovery of Salmonella Typhimurium from all samples with 42 percent moisture content and from 5 to 6 samples with 23 percent moisture content. It was isolated from all samples of 73 percent moisture content exposed to a CT product of 1600 mg h/1, At 10 degrees, exposure to MeBr at a CT product of 1600 mg h/1 was insufficient to prevent isolation of Salmonella Typhiumurium from all samples, irrespective of their moisture content. The E. coli present showed a susceptibility to MeBr similar to that of Salmonella Typhimurium, but micrococci were more resistant. Salmonella Typhimurium could be isolated from samples of dry litter exposed to levels of MeBr less than 800 mg h/1. The degree of disinfection achieved, in terms of percentage reduction, by levels as low as 100 mg h/1, was as high as 97 percent even at 10 degrees. (Cartmell-East Central).

## 1829-A6, B2, D3, F1

### THE TREATMENT OF MANURE IN OXIDATION DITCHES

Department of Agricultural Economics
Purdue University
Lafayette, Indiana
W. H. M. Morris
Paper submitted to Purdue Agricultural Experiment Station for publication, Research supported by Purdue Agricultural Station Projects No. 1349 and 1407, 34 p. 12 fig, 6 tab, 49 ref.

Descriptors: *Farm wastes, *Waste treatment, *Oxidation lagoons, Aerobic conditions, Odor, Sludge, Costs, Design, Bacteria, Nitrification, Denitrification.
Identifiers: *Manure, *Oxidation ditches.

The basic difference between aerobic and anaerobic waste treatment systems is that of odor control. The best aerobic treatment for odor control is an oxidation ditch. The basic form of the system is a race track shaped circuit. In the circuit there is an aeration rotor which provides oxygenation and circulation of the liquid. When a certain level of liquid is reached, a float stops the rotor and a time clock lets the liquid settle for 35 to 40 minutes. Then fresh water is pumped into the ditch and the effluent may run off through a siphon tube. Under this process there will be an accumulation of sludge. By maintaining the $OC/BOD_5$ ration at 2:1, there will be some oxidation of the sludge. Sludge may be removed by sludge traps or pumping onto drying beds. Construction costs of the ditch average about $8.50-$14.00/head assuming 10.6 cu, ft/head. Results given from test sites in Europe, United States and Canada indicate that the oxidation ditch can treat livestock manure aerobically. The problems they have encountered are sludge management, foaming, freezing and the determination of the proper aeration rotor size to prevent the ditch from going anaerobic. (Marquard-East Central).

## 1830-A2, A4, B2, B4, E1, E2, F2

### LIQUID MANURE MANAGEMENT FOR SWINE

Texas Agricultural Extension Service
Texas A&M University
College Station, Texas 77840
B. R. Stewart and J.M. Sweeten
Agricultural Extension Service paper, Texas A&M University, College Station, Texas, June 15, 1972, 24 p. 2 fig, 5 tab, 5 ref.

Descriptors: *Liquid wastes, *Farm wastes, *Management, *Hogs, Waste storage, Waste treatment, Waste disposal, Legal aspects, Lagoons, Regulation, Runoff, Confinement pens, Rates of application, Nutrients, Irrigation.
Identifiers: *Manure, Land disposal, Storage pits,

Texas regulatory guidelines are stated which give minimum requirements for preventing water pollution from confined feeding operations. Treated or untreated wastes may not be discharged to water courses except under rare rainfall events; therefore, alternative measures must be used. For confinement operations, this may mean: (1) daily scraping and cleaning of wastes for lagoon or pit storage, followed by land disposal, (2) use of slatted floors for collecting animal wastes in storage pits, followed by land disposal, or (3) use of slatted floors for catching animal wastes in shallow under-floor pits which discharge continuously into an outside lagoon. Pasture and open lot operations require solid waste management techniques, with the exception of having to catch rainfall runoff in retention ponds. Specific design and management requirements are given for liquid waste storage, treatment, and land disposal of swine wastes. (Marquard-East Central).

## 1831-A2, A4, B2, F1, F2

### EPA AND THE LIVESTOCK FEEDER

Executive Vice President
National Livestock Feeders Association
Omaha, Nebraska
B.. Jones
Agricultural Engineering, Vol. 55, No. 3, p. 30-31, March, 1974. 2 fig.

Descriptors: *Livestock, *Feed lots, *Water pollution control, *Costs, *Regulation, Runoff, Iowa.
Identifiers: *Environmental Protection Agency, Tenant farmers.

Livestock operators are faced with many installation and maintenance costs in maintaining adequate pollution control facilities. One of the problems is that such "investments" are not cost-reducing or production-increasing. It was calculated that an initial installation investment for surface runoff control facilities or over $700 million would be required for beef cattle, hog, lamb and dairy control facilities in this country in order to meet regulations requiring the containment of surface runoff from a 10-year, 24-hr, storm. Livestock operators usually must absorb cost increases. The cost of implementing environmental regulations may prove the exception if many producers are forced out of business. (Cartmell-East Central).

## 1832-A4, C2

### DETERMINATION OF AMMONIA IN AQUARIA AND IN SEA WATER USING THE AMMONIA ELECTRODE

The New England Aquarium,
Boston, Massachusetts.
R. Gilbert, and A. M. Clay
Analytical Chemistry, Vol. 45, No. 9, p. 1757-1759, August, 1973. 1 fig, 2 tab, 7 ref.

Descriptors: *Ammonia, *Aquaria, *Sea Water, *Electrodes, Equipment, Sampling, Analysis, Ureas, Temperature, Hydrogen ion concentration.
Identifiers: *Reagents.

An experiment was conducted with an electrode for the analysis of ammonia in aqueous solutions. The electrode consisted of a hydrophobic gas-permeable membrane which separated the alkaline test solution from an internal solution O. 1 M in ammonium chloride. A glass pH electrode and a silver chloride reference electrode were immersed in the internal solution. Experimental apparatus, reagents, and procedures are given in detail. Electrode response is a function of ammonia concentration with faster response at higher ammonia levels. Several compounds were studied as possible interference in the ammonia analysis. Urea and the lowest molecular weight amino acid, glycine, did not interfere. Making a sample $10^{-4}$ M in dimethylamine did affect the electrode potential, The data indicated that the electrode provides an accurate means of analyzing ammonia in sea water and that it is usually more precise than the spectrophotometric method. (Cartmell-East Central).

## 1833-A1, B1, C1, C2, C3, E1, E3, F2

### AGRICULTURAL WASTES

Mississippi State University,
State College.
E. C. McGriff and A. Shindala.
Journal Water Pollution Control Federation, Vol. 45, No. 6 p. 1167-1173, June, 1973. 63 ref.

Descriptors: *Farm wastes, *Livestock, Chemical properties, Physical properties, Waste treatment, Lagoons, Fuels, Recycling, Waste disposal, Methane, Feeds, Legal aspects, Regulation, Permits.
Identifiers: *Agricultural wastes, Land disposal, Pyrolysis.

This review of data from many investigators concerns waste characteristics, pollution abatement practices, waste use and reuse, and waste management and legal action. Specific investigations are cited. No conclusions are made by the author himself. (Frantz-East Central).

## 1834-A2, B2, E2, F1

### YOU HAVE TO "THINK MAINTENANCE" IN MANAGING FEEDLOT RUNOFF SYSTEMS

Nebraska Farmer, February 3, 1973, 2 p. 3 fig.

Descriptors: *Feedlots, *Agricultural runoff, *Operation and maintenance, Costs.
Identifiers: *Debris basin, *Holding pond, Waste management.

Feedlots need proper maintenance. The best designed runoff control system can fail if it cannot be maintained properly. To keep cleaning chores easy, this feedlot operator has installed gates at the end of debris basins and lot fences on the top of debris dikes. These are used so that scraper equipment can remove manure solids which would have been left on the fence row and prevent the manure from being pushed under fence lines by livestock traffic. The final phase of the runoff system is a holding pond which holds storm runoff and pumps the wastes onto field crops. Problems of the system have been clogged slots caused by manure solids and hair and problems in pumping the wastes out of the holding pond onto field crops. (Marquard-East Central).

## 1835-B1, E1

### STRUCTURES AND ENVIRONMENT HANDBOOK

Midwest Plan Service.
Publication MWPS-1, Midwest Plan Service, Iowa State University, September, 1973, 364 p.

Descriptors: *Planning, *Structures, *Environment, *Waste disposal, *Design, Livestock, Materials, Loads, Construction, Utilities.
Identifiers: *Handbooks, Fruit and vegetable storage.

This handbook is the fifth annual revision and first overall rewrite of a continuing program to bring facts, concepts, and relationships to teachers, students, and practitioners in the field of farm structures. Four large sections present structures, waste disposal, the environment, and the planning of a farmstead. The section on structures deals with materials, designs, loads, and construction of farm buildings. The environment section discusses fundamentals of environmental control of buildings. It then applies these fundamentals to different animal buildings. Also environmental considerations of fruit and vegetable storage is discussed in this section. Methods of waste disposal are presented in the next section with tips on construction. The planning section presents information on planning of livestock, crops, and water supply. The handbook is concluded with an appendix on beam formulas. (Russell-East Central).

## 1836-A11, B3, E3

### FEEDING POULTRY MANURE TO ANIMALS

Department of Poultry Science,
Texas A&M University,
College Station.
J. R. Couch.
Feedstuffs, Vol. 44, p. 24-25, 27, July 31, 1972. 6 ref.

Descriptors: *Feeds, *Excreta, Sheep, Nutrients, Performance.
Identifiers: *Dehydrated poultry waste, *Refeeding, Layers, Swine, Energy content.

This review of recent research, indicates that broiler chicks could tolerate five percent of dehydrated poultry waste (DPW). Growth decreased significantly when the percentage was raised to ten and twenty due to low energy content. No effect on egg taste or storage quality was detectable when laying hens were fed ten, twenty, or thirty percent DPW. DPW was recycled in the same poultry through 14 cycles or 12 days each in some tests. At 12-½ percent no adverse effects appeared, but at 25 percent the effects of the low energy content were clearly present. The age of manure at the time of drying is critical, and the method of drying is important. Manure for feed should be dried daily. Swine showed depressed feed conversion with as little as five percent DPW. Sheep can obtain up to fifty percent of their total nitrogen intake from DPW without adverse effects. Approximately forty nutritionists agree unanimously that "the best place to use dehydrated poultry waste was in beef cattle rations. (Whetstone, Parker and Wells-Texas Tech University).

## 1837-B2, D1, D3, E1, F1

### A MODEL STUDY OF MECHANICAL AERATION AS RELATED TO AGRICULTURAL WASTE DISPOSAL SYSTEM APPLICATION

J. J. Kolega.
PhD Thesis, Department of Agricultural Engineering, Oklahoma State University, 1968, 89 p. 23 fig, 6 tab, 39 ref.

Descriptors: *Model studies, *Aeration, Equipment, Equations, Iowa, Slurries.
Identifiers: *Oxidation ditch, *Mechanical aerators, Scotland.

Objectives for the study were to evaluate the efficiency of mechanical aerators for agricultural waste disposal systems and to develop a prediction equation for describing the effectiveness of a rotor paddle aerator for transferring oxygen from air to a liquid. A unique laboratory method was developed for use in the engineering design and analysis of a paddle wheel aerator system. This procedure can be used to obtain quantitative prediction equations for estimating and evaluating mechanical aerator systems. The oxygen transfer coefficient per revolution of rotor can be defined by the prediction equation given. The oxygen transfer coefficient per revolution of rotor is analyzed. (Frantz-East Central).

## 1838-A2, A4, C2, C3

### WATER POLLUTION POTENTIAL OF CATTLE FEEDLOT RUNOFF

J. R. Miner.
PhD Thesis, Department of Chemical Engineering, Kansas State University, 1967, 151 p. 19 fig, 37 tab, 85 ref.

Descriptors: *Feedlots, *Agricultural runoff, *Cattle, *Water pollution, *Irrigation, *Model studies, Kansas, Analysis, Chemical properties, Hydrology, Bacteria.

The characteristics of cattle feedlot wastes and their pollution potentials were evaluated in this model study. Twelve irrigation sprinklers provided simulated rainfall of 0.40 to 2.5 inches per hour onto two experimental feedlots. One lot was unsurfaced; the other was concrete surfaced. Data were collected to determine the amounts of rainfall necessary to produce runoff under various feedlot conditions. Runoff samples were collected and analyzed. A COD/BOD quotient was determined from a series of 48 runoff samples. Chemical constituents of the feedlot runoff were studied. Bacteriological populations in the runoff were found to be higher in warm weather and under conditions which produced maximum solubility of feedlot wastes. It was concluded that cattle feedlot runoff is a high strength organic waste. The decision on the best treatment and control measures is based on feedlot size, climate of the area, the nature of the receiving stream, the downstream water users, the space available for treatment facilities, and the overall cost of suitable alternates. (Frantz-East Central).

## 1839-B2, B4, E1, F1

### ECONOMIC EVALUATION OF LIQUID MANURE DISPOSAL SYSTEMS FOR DAIRY CATTLE

Agricultural Economist, Farm Production Economics Division Economic Research Service, United States Department of Agriculture, stationed at the University of Wisconsin, Madison.
N. D. Kimball, L. V. Lenschow, and R. E. Rieck.
Bulletin R2199, College of Agricultural and Life Science, University of Wisconsin, Madison, August, 1970, 24 p. 8 fig, 5 tab.

Descriptors: Liquid wastes, *Waste disposal systems, *Economics, *Costs, *Dairy industry, Waste storage, Equipment, Facilities, Labor.

This analysis reports experiences of the first Wisconsin dairy farmers who installed liquid manure disposal systems. These liquid manure systems include: (1) free-stall, all liquid, (2) free-stall, liquid-conventional, (3) stanchion, all-liquid, (4) stanchion, liquid-conventional. Comparisons are made of liquid manure storage, facility investments, annual costs, and costs and returns analysis. The most economical manure-handling system depends on many variables. The net disposal costs depend upon both the value of the manure and the cost of disposing the excrement. By changing the amount on nitrogen, phosphorus, and potassium recovered and making different assumptions regarding operating and ownership costs, the optimum system of manure disposal would change. In addition, installation costs are only the out-of-pocket costs —farmers did not report a charge for their own labor. Therefore, each farmer must ask himself whether the assumptions used in this study agree with his particular situation and then interpret the results accordingly. (Merryman-East Central).

## 1840-A11, B3, C1, C2, D1, D2, E3

### PROCESSED POULTRY EXCRETA RECYCLED AS A FEED INGREDIENT

Department of Poultry Science,
Michigan State University.
H. C. Zindel and C. J. Flegal.
Proceedings of the 1969 National Poultry Litter and Waste Management Seminar, Salisbury, Maryland, September 29-30, 1969, p. 103-118. 3 tab.

Descriptors: Nutrients, Performance, Sampling.
Identifiers: Dried Poultry Waste, *Refeeding, Pollution.

Growth trials were conducted to determine the nutritional value of the dehydrated poultry waste product. Feed efficiency appeared to be inversely proportional to the amount of dehydrated poultry waste in the ration. In growth trials, no significent differences were found in mean body weight of Leghorn type chicks fed up to 20 percent of dehydrated waste in their ration compared with broiler type chicks. When more than 5 percent of the dehydrated poultry waste was added to the ration, reduced four-week mean body weights resulted. No differences were found in egg production, shell thickness, or Haugh score when up to 40 percent of the diet consisted of dehydrated poultry waste. Also, taste tests indicated that the taste or flavor of eggs from chickens fed DPW was no different from eggs from chickens fed a normal ration. Tests were also conducted to see what would happen if the poultry manure from chickens receiving DPW was redried and fed again continuously. There was no egg production decrease; the crude protein level decreased; and the color of the dried material appeared to turn black. (Russell-East Central).

## 1841-A6, C2

### PROCEDURE TO IDENTIFY MALODORS FROM ANIMAL WASTES

Department of Agricultural Engineering,
Ohio State University, Columbus.
R. K. White and E. P. Taiganides.
Presented at the 1969 Annual Meeting, American Society of Agricultural Engineers, Lafayette, Indiana, June 22-25, 1969, Paper No. 69-425, 13 p. 6 fig, 19 ref.

Descriptors: Odor, *Gas chromatography, Sampling, Methodology, Analysis.

An equilibration collecting and concentration procedure of sampling odors from animal wastes for gas chromatographic analysis is presented and compared with other methods. Several methods of sampling are reviewed: sampling the source, salting out, selective chemical absorption and regeneration, cryogenic collection, and equilibration sampling. In the equilibration sampling technique used in this study, organic volatiles are passed over a liquid, stationary phase until the whole amount of the stationary phase reaches full equilibrium with the organic volatiles. Using a nonpolar stationary phase permits trapping the organic compounds while most of the water vapor passes through, provided the collector temperature is above the dew point. A variable stream splitter was installed in one of the columns of the gas chromatograph. This permitted sensory evaluation of each fraction separated so that qualitative, quantitative, and odor intensity analyses might be made on the significantly odorous peaks. Chromatograms of samples collected by the equilibrium technique indicated that some forty to fifty different compounds are present in the head space gases over dairy cattle wastes. This analysis of organic volatiles was considered to be more representative of the source than any of the other known procedures. (Solid Waste Information Retrieval System).

### 1842-A6, B2, D2, D3, E3

### WLJ PREVIEWS FIRST COMMERCIAL MANURE SYSTEM

G. Richardson.
Western Livestock Journal, Vol. 51, No. 1, p. 1, 7, November 6, 1972. 2 fig.

Descriptors: *Aerobic treatment, Dairy industry, Feedlots, Foam separation, Recycling, Lagoons, Degradation (decomposition).
Identifiers: *Licom waste treatment system, *Odor control, Centrirator, DeLaval Separator Company, Pasteurization.

DeLaval Separator Company has introduced a new invention, the Licom Waste Treatment System, which can turn farm wastes into clear water and odor-free, pathogen-free mulch. Licom Systems I and II may be used for smaller operations while Licom III is used for those feedlots which must meet rigid ecological requirements. Licom I uses a liquid manure collecting pit which fills a reactor once weekly with wastes. In the reactor, aerobic bacterial action raises the temperature into the thermophilic range and in 5 to 7 days complete stabilization, decomposition, and pasteurization have occurred. Licom II uses the same procedure only with more reactors for more complete decomposition. Licom III is like Licom II with the addition of a flotation tank that separates fibrous matter from the liquid. For feedlots already using lagoons, a DeLaval Contrirator may be installed which will eliminate odors. (Marquard-East Central).

### 1843-A8, E2

### WATER INTAKE RATES ON A SILT LOAM SOIL WITH VARIOUS MANURE APPLICATIONS

Agricultural Engineering Department,
Nebraska University, Lincoln.
O. E. Cross and P. E. Fischbach.
Presented at the 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-218, 13 p. 9 fig, 4 ref.

Descriptors: *Irrigation.
Identifiers: *Water intake rates, *Silt loam soil, *Manure applications, Application rate.

The application of manure to cultivated and irrigated soils changes the intake rate of irrigation water when compared to the intake rate of non-manured soils. This paper presents the findings of two years of irrigation study on manured soils. Conclusions were:

(1) The initial water intake rate increased as the quantity of manure application increased.
(2) The basic water intake rate increased as more time from date of manure application had elapsed.
(3) Manure application decreased the basic intake rate as compared to the basic intake rate of non-manured silt loan soil.
(4) Depth of plowing did not appreciably affect the basic intake rate. (Marquard-East Central).

### 1844-B1, B2, B4, C1, C2, D3

### FORMS OF NITROGEN IN ANIMAL WASTE

Agricultural Engineering Department,
Purdue University,
West Lafayette, Indiana.
R. E. Jones, J. C. Nye and A. C. Dale.
Presented at the 66th Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-439, 15 p. 1 fig, 8 tab, 6 ref.

Descriptors: *Nitrogen compounds, Waste treatment, Waste storage, Climates, Aerobic conditions, Anaerobic conditions, Lagoons, Denitrification, Indiana.

Wastes from an aerobic lagoon, an anaerobic lagoon and a concrete manure storage tank were studied to determine seasonal variations on denitrification. Waste samples from all over Indiana were analyzed for Kjeldahl nitrogen, ammonium, and nitrate-nitrite nitrogen and solids. It was observed that type of livestock waste and type of waste management practice influenced the amounts of Kjeldahl nitrogen, in which most farm waste nitrogen was found to exist. Dairy wastes under either aerobic or anaerobic conditions are influenced by climatic variations. While approximately 65 percent of nitrogen is lost in aerobic conditions, greatest nitrogen loss in swine wastes occurred under anaerobic conditions. (Frantz-East Central).

### 1845-A5, A8, C2, E2

### ANIMAL WASTE AND NITRATE MOVEMENT THROUGH SOIL

Agricultural Engineering Department,
Connecticut University, Storrs.
J. A. Lindley, A. C. Dale and J. V. Mannering.
Presented at the 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 17 p. 6 fig, 11 tab, 6 ref.

Descriptors: *Animal wastes, *Groundwater pollution, *Nitrates, *Leaching, *Denitrification, Soil moisture.
Identifiers: *Application rates, *Land disposal, Silt loam, Sandy loam.

An evaluation of high application rates of animal wastes to land becomes necessary as the number of animals per acre of land increases. The application rate must be controlled to prevent ground water degradation. A laboratory study was done to evaluate the effects of waste management on nitrate movement through soil. The fate of nitrate is dependent on various conditions. The most important are soil moisture conditions and the presence of sufficient organic matter for microbial activity. Soil type might also affect nitrate movement. Leachates of very low nitrogen concentration can be produced even with waste application of 24.6 pounds of nitrate per acre-day. It was observed that the amount of nitrogen lost increases with increasing available energy (C:N ratio). (Kehl-East Central).

### 1846-A2, B2, B3

### RISER INTAKE DESIGNS FOR FEEDLOT SOLIDS COLLECTION BASINS

Agricultural Research Service,
U.S. Department of Agriculture,
Lincoln, Nebraska.
C. L. Linderman, N. P. Swanson, and L. N. Mielke.
67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-3030, 7 p. 3 fig, 5 ref.

Descriptors: *Feedlots, *Solid wastes, Agricultural runoff.
Identifiers: *Collection basins, *Riser intake designs.

Given the size and shape of a feedlot debris basin, a riser intake and conduit can be designed to remove the runoff from the design storm within a desired time. Either corrugated metal pipe or plastic pipe with 5/8-inch drilled holes has proven very satisfactory for riser intakes. Comparisons of material requirements, installation labor, and operating experiences indicate that either type of intake is equally satisfactory, with the choice dependent on operator preference. Zinc-plated CMP is not excessively deteriorated by contact with runoff and animal wastes. If the basins are cleaned before solids accumulation seriously interferes with drainage, the intakes will operate with little maintenance. (Linderman, Swanson, & Mielke-USDA).

### 1847-B2, B3, D1, E2, E3

### CABLE DRIVEN SCRAPERS FOR MANURE COLLECTION AND LIQUID SOLID SEPARATION

Agricultural Engineering Department,
North Dakota State University, Fargo.
G. L. Pratt, M. L. Buchanan and R. L. Witz.
Presented at 1974 Summer Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 14 p. 8 fig, 7 tab, 5 ref.

Descriptors: *Liquid wastes, *Solid wastes, *Separation techniques, Drying, Design.
Identifiers: *Cable driven scrapers, Slatted floors, Land spreading, Refeeding.

An integrated system for manure collection and liquid solid separation satisfies several desirable requirements for manure management in closed mechanically ventilated barns. These requirements include separation of manure from livestock by floor slats; daily removal of manure from barns; and separation of liquid wastes from solids for efficient handling and utilization. Pollution is kept to a minimum since no clean water is added to the system. Free liquid wastes make up about one third of the total weight of the liquid in the manure from animals. The fecal waste is removed from the building at 80 percent moisture and handled with conventional manure handling equipment. Because dewatering is accomplished by this system, dehydration is more feasible. Moisture removal from the fecal waste helps to control odors, reduces the bulk of material that must be handled, and puts it into a form that is more readily acceptable for utilization. (Cameron-East Central).

### 1848-A8, C2, E2, F6

### MODEL OF NITRATE PRODUCTION AND MOVEMENT IN MANURE DISPOSAL PLOTS

Department of Agricultural Engineering,
Pennsylvania State University,
University Park.
R. M. Butler.
Presented at 66th Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-426, 27 p. 7 fig, 6 tab, 10 ref.

Descriptors: *Computer models, *Nitrates, *Movement, Solids, Denitrification.
Identifiers: Land application.

A digital computer model was developed for simulating nitrate production and movement for wastes applied to soils. It accounted for nitrate production, nitrate uptake by plants, denitrification, and nitrate movement with the soil water. Manure was mixed with soil at rates of 0, 2.25 percent, 4.50 percent and 9.00 percent. Initially, nitrate production decreased, then increased exponentially. After 110 days, the rate of nitrate production decreased for all four treatments; after 200 days the nitrate-nitrogen content of the mixture was 23, 27, 32, and 48 mg/100 gm dry matter, respectively. The digital computer model was tested by comparing the predicted nitrate-nitrogen production and the predicted nitrate concentration of the soil water with field measurements for May through November, 1970. (Frantz-East Central).

### 1849-A11, B5, C3, D2

### THE USE OF FORMALDEHYDE FLAKES AS AN ANTIMICROBIAL AGENT IN BUILT-UP POULTRY LITTER

Department of Poultry Science,
North Carolina State University, Raleigh.
J. R. Veloso, P. B. Hamilton and C. R. Parkhurst.
Journal Series of the North Carolina State University Agricultural Experiment Station, Raleigh, Paper Number 3971, p. 78-83. 4 tab, 4 ref.

Descriptors: *Poultry, *Litter, *Waste treatment, Performance, Molds, Bacteria.
Identifiers: *Formaldehyde flakes.

This study was designed to investigate the effect of different concentrations of formaldehyde flakes on the bacterial and fungal populations of built-up litter and on the performance of broilers raised on such treated litter. The bacterial count of the litter containing 3 percent formaldehyde flakes was reduced to at least one-tenth of the control value for three weeks, after which the count returned to control values. The mold count was reduced at both 1 and 3 percent concentrations of formaldehyde flakes for about 2 weeks. The pH of the litter at 3 percent level of formaldehyde flakes was reduced significantly for three weeks. There was an increase in temperature of up to 4 degrees C above the control value in the litter containing 3 percent flakes and 3 degrees C in the litter containing 1 percent flakes. There were some possible side benefits to the use of formaldehyde flakes in litter. The number of insects and rodents in litter appeared to be considerably reduced. The litter treatment had no significant effect on the mean body weight, feed conversion, or mortality. (Cartmell-East Central).

### 1850-A4, B1, E1, F2
### RULES AND REGULATIONS: CONFINED FEEDING OPERATIONS

Iowa Department of Environmental Quality.
Rules and Regulations: Confined Feeding Operations, Iowa Water Pollution Control Commission, 1971, 4 p.

Descriptors: *Regulation, *Iowa, *Waste water disposal, *Water pollution.
Identifiers: *Open feedlot, *Confinement feeding operation, *Registration.

An open feedlot (an unroofed or partially roofed adjacent or nearby animal enclosure on a single property) is defined in terms of specific animal populations and population densities. Confinement feeding operations (roofed or partially roofed adjacent or nearby animal enclosures on a single property from which wastes are removed as a liquid or semi-liquid) are defined in terms of maximum number of animals confined at one time. These data are given for beef cattle, dairy cattle, swine, sheep, turkeys, and chickens. Conditions requiring registration are outlined along with requirements for the facilities and for operation of the facilities. Feedlot pollution control facilities constructed in accordance with rules in effect at the time of construction shall not be required to be reconstructed due to subsequent rule changes unless the commission finds that waste discharge from such facilities is causing water pollution. Such facilities shall, however, be brought into compliance with rules in effect at the time of reconstructing, enlarging or otherwise modifying the confined feeding operations or control facilities. (Merryman-East Central).

### 1851-A2,A6,B1,B4,C2,D3,F2
### ODORS FROM LIVESTOCK PRODUCTION

Agricultural Engineering Department,
Oregon State University, Corvallis 97331.
J. R. Miner.
Report, Project Number S-802009, August, 1973, 127 p. 6 fig, 33 tab, 93 ref.

Descriptors: *Livestock, Ammonia, Measurement, Odor control, Management, Legal aspects, Nuisance.
Identifiers: Desorption, Identification, Feed additives, Chemical treatment.

Current livestock production techniques result in the generation of odors which have become a source of conflict between livestock producers and society. The odorous gases responsible for the nuisance are principally low molecular weight compounds released during anaerobic decomposition of manure. Manure management systems which control or modify this decomposition offer the greatest potential for odor control. Research to identify the chemical compounds present in odorous air from animal waste degradation has yielded about 45 compounds to date. The amines, mercaptans, organic acids and heterocyclic nitrogen compounds are generally regarded as being of greatest importance. Among the techniques for odor control are: (a) site selection away from populated areas and where adequate drainage exists, (b) maintain the animal areas as dry as possible and prevent the animals from becoming manure covered, (c) select manure handling systems which utilize aerobic environments for manure storage, (d) maintain an orderly operation free of accumulated manure and runoff water, (e) practice prompt disposal of dead animals and (f) use odor control chemicals when short term odor control is necessary, such as when manure storage tank contents must be field spread. (Miner-Oregon State University).

### 1852-B2, B3, C1, D1
### VACUUM FILTRATION OF CATTLE MANURE

Sanitary Engineer, United States Army,
Security, Colorado.
L. F. Backer, R. L. Witz, G. L. Pratt, and M. L. Buchanan.
Presented at the 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, Paper No. 73-4531, 9 p. 8 fig, 3 ref.

Descriptors: Slurries, Sludge, Moisture content.
Identifiers: *Vacuum filtration, Manure, Liquid-solid separation.

A vacuum filter was used to separate solids from liquids in manure. Manure solids and liquids for the tests were gathered daily from a barn housing beef feeder cattle. Temperatures in the barn were controlled at about 45 degrees F. Two slurry mixtures were used, one having a moisture content of 87 percent and the second 91 percent. The type of filter fiber, the speed of rotation of the drum, and the percent submergence of the drum in the slurry were variables which affected the performance of the drum type vacuum filter. The yield of solids as affected by the drum speed, initial moisture content, and the drum submergence is presented. The initial cost of vacuum filter equipment is quite high. Cake and filtrate yields are generally small due to poor filtering characteristics of chemically unconditioned and undigested manure. If the manure were allowed to digest anaerobically, and if it were chemically conditioned, yields possibly would increase. Both practices would increase the cost of manure handling and disposal. (Cameron-East Central).

### 1853-A9, A10, B1
### INTEGRATED FLY-CONTROL PROGRAM FOR CAGED POULTRY HOUSES

Department of Entomology,
North Carolina State University, Raleigh.
R. C. Axtell.
Journal of Economic Entomology, Vol. 63, No. 2, p. 400-405, April, 1970. 9 fig.

Descriptors: Insecticides, Manure.
Identifiers: *Fly control, *Caged poultry houses.

In two successive years, fly control programs were tested at three farms and compared with data from three untreated farms. The program was based on the following strategy: Selective application of insecticides would be against adult flies. Control measures would be applied early in the spring before flies appeared and would be repeated as needed. Finally, manure would remain undisturbed throughout the summer months when fly breeding occurs. Excellent control results are obtained by this method, especially when the first application of insecticide to walls and beams, where the adults breed, is done early, and then repeated four or five times during the season. Insecticide bait mixtures should be provided as well. This spray seems to have no effect on predacious mite fauna in manure. To maintain maximal populations of predators, manure should be partially removed at frequent intervals of low fly activity or removed only once a year in cool weather. These recommendations are founded on the fact that total removal of manure decimates mite population, while fresh droppings are most conducive to fly breeding. (Solid Waste Information Retrieval System).

### 1854-A7, A11, B3, C2
### TWO WAYS TO REDUCE AMMONIA LEVEL IN BROILER HOUSES

Extension Poultry Scientist,
Georgia University, Athens.
M. Y. Dendy.
Poultry Digest, Vol. 32, No. 377, p. 306-307, July, 1973. 1 fig.

Descriptors: *Ammonia, *Litter, Ventilation, Cleaning.
Identifiers: *Broilers, Respiratory diseases, Eye irritation.

Reused litter became common several years ago when it seemed evident that broilers on reused litter had lower condemnations due to Marek's disease. Another justification was that wood shavings and labor were getting scarce and high priced for cleaning out houses. However, Marek's vaccine is now in widespread use and substitute litter materials can usually be found if the feeder looks hard enough. The practice of reusing litter often causes unwarranted amounts of ammonia. Stress has been demonstrated to occur when ammonia exceeds 50 ppm. High levels of ammonia can cause severe eye irritation, blindness, and respiratory diseases in poultry. The solution to this problem is (1) a controlled ventilation system, or (2) more frequent clean-out. (Merryman-East Central).

### 1855-B2, B3, D1
### A ROTATING FLIGHTED CYLINDER TO SEPARATE MANURE SOLIDS FROM WATER

Sanitary Engineer, Kansas State Department of Health and Environment, Topeka.
W. E. Verley and J. R. Miner.
Transactions of the ASAE, Vol. 17, No. 3, p. 518-520, 525, May-June, 1974. 6 fig, 3 tab, 3 ref.

Descriptors: *Solid wastes, *Separation techniques, *Settling basins, Weirs, Hydraulic transportation, Design.
Identifiers: *Rotating flighted cylinder.

Because of the advantages of solid-liquid separation in liquid manure systems and the high cost of present separation devices, a separator was developed at the Oregon State University dairy barn at Corvallis. The design concept was a series of circular weirs which formed a series of small settling basins with the weirs as the basin outlets. Solids settled into the basins which were moved slowly up an incline. The solids were then dumped at the upper end of the incline along with any trapped water. The separating device yielded these results. No plugging or other mechanical problems occured. The device failed to receive a representative sample of manure solids. The solids rich fraction discharged at the upper end contained too much water. The design was revised so that the shell diameter was increased to 24 in. and the basic flight depth was increased to 6 in. The flights were on a 4 in. spacing. This device has certain desirable features for solid-liquid separation. The construction of a larger diameter tube allows increase of volumetric capacity. It consumes little power and has no plugging problems. The concept is simple and has potential application wherever it is desired to concentrate solids or claim a water for reuse. (Merryman-East Central).

### 1856-A11, C2, D2, D3, E3
### RUMINANT FEEDING VALUES PREDICTED FOR ENSILED ANIMAL AND CROP WASTES

W. W. Saylor, T. A. Long, and L. L. Wilson.
Science in Agriculture, Vol. 20, No. 4, p. 10, Summer, 1973.

Descriptors: *Ruminants, *Feeds, *Silage, Nutrients, Alkalie.

Identifiers: *Ensiled animal and crop wastes, Digestibility.

Laboratory results indicate that ensiled animal and field waste can be used economically as a source of nutrients for ruminant animals, thereby reducing the pollution problem. Ground cornfield residue or oatstraw, 40 percent, was ensiled with cattle manure or poultry manure, 60 percent, on a fresh moisture basis. Sodium hydroxide, potassium hydroxide, or ammonium hydroxide — each an alkali — was added, at 4 percent of the treatment dry matter, to each combination. The moisture level of all silages was adjusted to 55 percent and all treatments were prepared in replicates of four. Each replicate was stored at 86 degrees F during a 60-day fermentation period. Contents were then analyzed for crude protein and digestible organic matter. Silages containing oat straw were superior to those made with cornfield residue. Average crude protein values were 13 percent for cattle waste and 14 percent for poultry waste. Digestible organic matter was greater for silages treated with ammonium hydroxide than for the other treatments. However, when the cost, corrosiveness, and possible dangers involved with the use of alkalies are considered. the increase in digestible organic matter is probably not sufficient to justify its use. The best silage in this study was the oat straw-poultry waste combination. (Merryman-East Central).

## 1857-A2, A8, B2, E2, F1

### LOW-COST DISPOSAL SYSTEMS FOR FEEDLOT RUNOFF

Agricultural Research Service,
U.S. Department of Agriculture,
Lincoln, Nebraska.
N. P. Swanson and C. L. Linderman.
Agricultural Engineering, Vol. 55, No. 11, p. 20-21, November, 1974. 3 fig.

Descriptors: *Agricultural runoff, *Feedlots, *Disposal, *Costs, Irrigation.
Identifiers: Sprinkler irrigation, Gravity flow.

Cattle feeders are required by law to control runoff from their feedlots. The most practical method for disposing of runoff is land disposal through irrigation. The feeder needs a low-cost disposal system that is fitted to a minimum land area. The Soil Conservation Service recommends a disposal area 1½ to 2 times larger than the contributing feedlot, but the specific area needed for disposal to empty the holding pond at any one time should be no longer than the feedlot. The runoff may be disposed of by a gravity flow system or through sprinkled irrigation. Gravity disposal through gated pipe, hoses, or single point discharge may require land preparation, some form of pump, protection from freezing, and it may require more labor. Sprinkler distribution requires more power, may require a reuse pit due to the runoff caused by the distribution, and may cause excess wetting during the seedling stage or just before harvest, thus damaging crops. Care must be taken in selecting irrigation components and in scheduling field applications. The larger the system, the more consideration should be given to application and distribution efficiencies. The most important considerations for smaller systems are low investment and labor costs. With either type, care must be taken to avoid ponding and mosquito breeding. Also the area should be located to take advantage of prevailing winds to avoid odor build-up near residences. (Merryman- East Central).

## 1858-D3, E3

### FERMENTATION HEADS FOR HIGHER PRODUCTIVITY

Chemical and Engineering News, Vol. 51, No. 12, p. 32-34. March 19, 1973. 2 fig.

Descriptors: *Fermentation, Recycling, *Waste treatment, Proteins, Farm wastes, Mathematical models, Feeds, Bacteria.
Identifiers: Drugs, Animal wastes, General Electric.

This paper contends that closer control of a complex biological process—fermentation—promises large cuts in the costs of making drugs and protein, and of recycling wastes. Scientists are now mathematically modeling fermentation processes and setting up computer systems to find the best set of reaction parameters. The energy squeeze could also figure largely in the future of fermentation. The use of a computer along with fermentation has provided a system that can log and instantly reduce and analyze physical and metabolic parameters of fermentation. As to applications of the process, a microbolic attack on animal wastes currently involves General Electric in a project raising high-protein bacteria on animal wastes. Product bacteria would be tested as animal supplements. The market could also include fermentation applications in drug processing and enzyme production. (Solid Waste Information Retrieval System).

## 1859-A7, D2, E3

### PROCESS CONVERTS ANIMAL WASTES TO OIL

Chemical and Engineering News, Vol. 49, No. 33, p. 43, August 16, 1971. 1 fig.

Descriptors: *Farm wastes, *Oil, *Feed lots, *Energy, *Waste treatment, *Waste disposal, Steam, Cellulose, Hydrogenation, Research and development, Fuels.
Identifiers: *Animal wastes, Carbon monoxide.

The U. S. Bureau of Mines' Pittsburgh Energy Research Center has developed an effective process, using carbon monoxide and steam, to convert manure or any cellulosic waste to oil with a percent yield. The mechanism of the reaction is unknown, although it may proceed through a formate ion. The constant product is a heavy oil with an energy content of 14,000 to 16,000 Btu per lb. The oil is paraffinic, and it has a low sulfur content of 0.35 percent which could prove useful in the future to the prevention of urban air pollution. (Solid Waste Information Retrieval System).

## 1860-A2, A3, A5, B1, C2

### ESTIMATING NUTRIENT LOADINGS OF LAKES FROM NON-POINT SOURCES

Wisconsin University, Madison. Water Resources Center.
P. D. Uttormark, J. D. Chapin, and K. M. Green.
Environmental Protection Agency report number, EPA-660/3-74-020, August, 1974, 112 p. 5 fig, 31 tab, 133 ref.

Descriptors: *Nutrients, *Eutrophication, *Control, Management, Drainage, Nitrogen, Phosphorus, Agriculture, Estimating, Chemical properties, Runoff, Groundwater, Fallout, Sewage, Precipitation (Atmospheric), Seepage, Urban runoff, Forests, Marshes, Wetlands, Septic tanks.
Identifiers: Lake management, Nutrient load, Nutrient sources.

Data describing nutrient contributions from non-point sources were compiled from the literature, converted to kg/ha/yr, and tabulated in a format convenient for estimating nutrient loadings of lakes. Contributing areas are subdivided according to general use categories, including agricultural, urban, forested, and wetland. Data describing nutrient transport by groundwater seepage and bulk precipitation are given along with data for nutrient contributions from manure handling, septic tanks, and agricultural fertilizers. Nutrient content of urban runoff was the highest; forested areas were lowest. Nutrient expert data for agricultural lands were tabulated as seepage through vertical soil profile, overland runoff, and transport by streams draining agricultural watersheds. The latter group was judged to be most applicable for estimating nutrient loading of lakes. Marshes appear to temporarily store phosphorus and nitrogen during the growing season and release them at a later time; net nutrient runoff is estimated to be near zero. Nutrient contributions to lakes from groundwater seepage require site-specific information for assessment. Phosphorus and nitrogen transport by groundwater can be significant, Atmospheric contributions of nitrogen are large in some areas. The technique of estimating nutrient loadings of lakes requires considerable judgment in selecting runoff coefficients; however, the approach provides insight into potential management options. (Uttormark-Wisconsin).

## 1861-A11, B3, D1, E3

### INCLUSION OF DRIED POULTRY WASTE AS A FEED INGREDIENT IN CATFISH RATIONS

Texas Agricultural and Extension Service, Texas A & M University, College Station.
J. C. Fowler and J. T. Lock.
Feedstuffs, Vol. 46, No. 44, p. 36, Oct. 28, 1974. 1 fig, 2 tab, 4 ref.

Descriptors: *Catfishes, *Diets, Proteins, Performance, Taste.
Identifiers: *Dried poultry waste.

A study was done to determine the feasibility of including air dried poultry waste as a feed ingredient in catfish rations. Air-dried manure was used in the diets at a dietary level of 25 percent. All diets were calculated to contain essentially equal amounts of crude protein assuming that the hen manure contained 21 percent protein. Catfish consuming diets containing air-dried poultry waste had better weight gain than catfish consuming the control diet over the 150 day feeding period, Taste panel evaluation of the test tissue and control tissue revealed no significant differences. (Cameron-East Central).

## 1862-B2, D1, D3

### BASIC PERFORMANCE PARAMETERS FOR OXYGENATION AND LIQUID CIRCULATION IN ROTOR-AERATED LIQUID WASTE SYSTEMS

Agricultural Engineering Department, Oklahoma State University, Stillwater.
G. L. Nelson, J. J. Kolega, U. Agena, Q. Graves, and G. Hoffman.
Presented at 1968 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, Dec. 10-13, Paper No. 68-932, 41 p. 15 fig, 5 tab, 17 ref.

Descriptors: *Rotors, *Performance, *Liquid wastes, Equations.
Identifiers: Parameters, Rotor-aerated tank, Oxygen transfer, Liquid circulation.

A study was made which concerned performance characteristics of rotor-aerated ditch or tank systems for livestock wastes. The purpose of this study was to: (1) identify the physical parameters that characterize oxygen transfer and liquid circulation effects in a rotor-aerated liquid waste system; and (2) based on these parameters, to develop prediction equations for oxygen transfer and for liquid circulation effects for one class of rotors. The study included experiments with two laboratory models, one each for oxygenation and liquid circulation. Conclusions drawn from the study include: (1) For a class of rotors, the dimensionless oxygen transfer parameter can be predicted for system design and operating purposes, (2) the oxygen transfer coefficients, $k_M$, of two geometrically similar rotors are directly proportional to the ratios of the products, (3) liquid velocity for rotor-driven circulation in a ditch can be estimated, (4) the ratio of channel length to width is non-critical in the range 5.8 to 10.0, and (5) the rotor Froude number is critical below a value of 0.15 for liquid circulation effects in a rotor-driven ditch. (Cameron-East Central).

## 1863-A4, A11, A12, C3

### METHODS FOR RAPID IDENTIFICATION AND ENUMERATION OF STREPTOCOCCUS BOVIS FROM WATER

L. R. Koupal
MS Thesis, Bacteriology Department, South Dakota State University, 1969, 53 p. 9 fig. 5 tab.

Descriptors: *Streptococcus bovis, *Analytical techniques, *Pathogenic bacteria, *Water pollution.
Identifiers: Identification, Raffinose.

This investigation was undertaken to find an isolation medium and a technique to make isolation of Streptococcus Bovis less difficult and more consistent. An attempt was also made to gather more information as to the length of time Streptococcus Bovis may be viable in a stream so that the value of this microorganism as a tracer for animal fecal pollution will be more clear. It was determined that raffinose serves to make the basal medium more selective for Streptococcus Bovis and that sodium azide at concentrations of 0.04 percent and greater inhibits the growth of Streptococcus Bovis. A 25 percent carbon dioxide and 75 percent nitrogen atmosphere over the cultures enhances the growth of Streptococcus Bovis while it maintains selectivity of a given medium. The starch agar layer method used in conjunction with the membrane filter and spread plate technique is an excellent method for rapid screening for streptococcus Bovis. Streptococcus Bovis exhibited the greatest persistence under the following conditions: in an organic concentration of .73 mg nitrogen per 100 ml, as peptone, in an aerated state, and at a temperature of 10 degrees C. (Cartmell-East Central).

## 1864-B5, C2, D3

### KINETICS OF GROWTH AND CONVERSION OF NUTRIENTS BY RUMEN MICROBES IN SOLUTIONS OF POULTRY EXCRETA

H. E. Hamilton
PhD Thesis, University of Kentucky, Lexington, May, 1971, 139 p. 64 fig. 4 tab. 32 ref.

Descriptors: *Kinetics, *Nutrients, *Conversion, *Poultry, Nitrogen, Microorganisms, Sampling, Fermentation, Incubation, Anaerobic conditions, Hydrogen ion concentration, Ethers.
Identifiers: Growth, Excreta, Rumen.

An experimental investigation was conducted to determine the effects of pH and manure when fermented with rumen fluid as an inoculum. All sampling, fermenting, and incubation were strictly anaerobic. Excreta from hens fed a drug-free diet was blended and diluted with water, sterilized, and placed in fermentation equipment with an indirectly driven agitator, automatic pH controller, temperature controller, foam controller, and sampling device. The solution was then inoculated with rumen fluid and fermented anaerobically for 48 hours. Samples were taken and freeze-dried as fermentation progressed. The dried samples were ground and proximate analyses made to quantitatively determine the major components. The specific growth of the microorganisms was higher for solution of pH 6.8 than for pH of 6.3 and 7.3. Maximum population was reached after 14 to 22 hours. There was no significant change in nitrogen and ether extract indices during the first 14 hours of fermentation; after which nitrogen index decreased and the ether extract index increased. The ash index showed no change during the first 6 hours of fermentation but steadily increased after that time. (Cartmell-East Central).

## 1865-A8, B3, D3, E3

### ANIMAL WASTE COMPOSTING WITH CARBONACEOUS MATERIAL

W. S. Galler
Summaries of Solid Waste Research and Training Grants, EPA Publication No. SW-5r. p. 6-7, 1971.

Descriptors: *Poultry, Nitrogen, Carbon.
Identifiers: *Animal wastes, *Composting, Sawdust, Soil amendment.

The objectives of the research reported are "to develop a process for composting a combination of chicken manure as a source of nitrogen and sawdust initially as a source of carbon to produce a valuable soil amendment." Laboratory studies of combinations of manure and sawdust with carbon-to-nitrogen ratios of 25:1 to 40:1 found them to be nutritionally balanced for microbial growth. The compost has proven to be a valuable soil conditioner. Swine manure may also be composted satisfactorily with sawdust although the mixture required a week to become thermophilic as opposed to one to two days for the poultry manure. (Whetstone, Parker, Wells—Texas Tech University).

## 1866-D3, E3, F1, F5

### PHOTOSYNTHETIC RECLAMATION OF AGRICULTÚRAL SOLID AND LIQUID WASTES

W. J. Oswald
Summaries of Solid Waste Research and Training Grants, EPA Publication No. SW-5r, p. 85-86. 5 ref.

Descriptors: *Solid wastes, *Liquid wastes, *Agriculture, Poultry, Anaerobic digestion, Algae, Effluent, Aeration, Costs.
Identifiers: *Photosynthetic reclamation.

In a pilot plant at Richmond, California, the wastes from a hen house were fermented in an anaerobic digestion tank with the effluent feeding directly into an algae pond. Water from the pond was used for flushing in the hen house, and the algae were fed to the hens. The pond was aerated during the winter. Algae production was 30 to 40 tons (dry wt.) per acre of pond. "The net waste-handling cost would be one cent or less per dozen eggs." (Whetstone, Parker, Wells-Texas Tech University).

## 1867-A5, A6, B2, B3, D1, D2, D3, E2, E3

### SURMOUNTING THE POULTRY WASTE PROBLEM

Department of Poultry Science
Cornell University
Ithaca, New York
C. E. Ostrander
Proceedings and Abstracts, XV World's Poultry Congress & Exposition, New Orleans, Louisiana, August 11-16, 1974, p. 219-221. 6 ref.

Descriptors: *Poultry, *Excreta, Anaerobic digestion, Dehydration, Odor, Methane, Fertilizers.
Identifiers: *Waste management, Deep pit house, High rise house, Oxidation ditch, Aerated pond, Soil injection.

Choice of a poultry waste management system is dependent upon location, climate, size of operation, amount of land, cropping possibilities, etc. Among poultry waste management choices are the following: (1) deep pit, (2) high rise, (3) anaerobic systems, (4) aerobic systems such as oxidation ditches and surface aeration, (5) soil injection, (6) dehydration and (7) methane production. Of the two dry systems (deep pit and high rise), the high rise house maintains dry manure conditions more easily. For both systems, groundwater seepage, excess water, and air circulation may be problems. Of the liquid systems, an anaerobic system would only be recommended for an isolated area due to its odor. Conversely, an aerobic system would be better for a populated area. Where odors are a problem at spreading time, soil injection may be used to eliminate the problem. Actual recycling* of farm wastes through methane production is still largely experimental. The use of dehydrated manure as a fertilizer is also being eyed with interest. (Merryman-East Central).

## 1868-B2, D3, E3

### DIGESTER — A SOURCE OF BIOELECTRICITY

The Papcock Farms, Inc.
Harni Road
Baroda—390002, Gujarat, India
H. B. Patel and J. D. Patel
Proceedings and Abstracts, XV World's Poultry Congress & Exposition, New Orleans, Louisiana, August 11-16, 1974, p. 221-223. 7 ref.

Descriptors: *Recycling, *Gases, *Poultry.
Identifiers: *Digester, *Bioelectricity, *Biofertilizer.

At Papcock Farms, Inc. in India, a self-contained system of 'Bioconversion' was established to convert poultry or animal wastes into an energy source and a biofertilizer. The wastes are mixed with water at a 1.2 ratio and fed to a 'digester.' In the digester the wastes undergo two basic processes—liquifaction and gasification. The gas is collected and used as fuel to run incubator brooders and a small gas engine. The gas is also used for cooking for a family of 40. The installation produces about 20 cubic meters of gas per day. The digested slurry is then nitrified by blue-green algae and used as a 'biofertilizer' on crop lands. This system has been used successfully since 1963 without soil or water pollution, odor, or occurrence of fecal-borne diseases. A similar, but somewhat more sophisticated, study has been performed by Dr. Frederic Sisler of the United States. A brief description is given. (Merryman-East Central).

## 1869-A11, B3, C2, D1, D2, E3, F1, F2

### RECYCLING DRIED POULTRY WASTES AS A WASTE MANAGEMENT SYSTEM

Agricultural Research Council's Poultry Research Centre,
King's Buildings, West Mains Road, Edinburgh EH9 3JS
Scotland
R. Blair
Proceedings and Abstracts, XV World's Congress & Exposition, New Orleans, Louisiana, August 11-16, 1974, p. 225-227. 5 ref.

Descriptors: *Recycling, Ruminants, Economics, Additives, Legal aspects, Public health.
Identifiers: *Dried poultry waste, *Dried poultry litter, *Waste management, *Refeeding, Nonruminants.

Solid waste as voided is about 80 percent water. Its bulk may be reduced through drying techniques. In this paper, dried poultry waste (DPW) and dried poultry litter (DPL) are considered. The main difference in DPL and DPW is a higher content of crude fiber in DPL due to the mixture of the droppings with litter. Studies have indicated that DPW and DPL are economic feedstuffs for ruminants and that they can play an important part in keeping down feed costs. They may also be used to supplement nonruminant diets with the same effect. Variability of composition of poultry waste can be a drawback, however. Also, recycling of animal waste is banned in most EEC countries and in the USA. In the UK the use of DPW is not prohibited unless it can be shown that the feed contains deleterious ingredients. DPL is in a different category since the presence of litter in a feed has to be declared. The main aim of legislation must be to prevent farm animals and the public from being exposed to unnecessary hazards as a result of recycling. DPL presents more of a potential from residues than DPW since birds on deep litter may also contain mycotoxins and wood preservation chemicals. Feeding this type of litter to ruminants would be inadvisable. Although risks exist, tests for bacterial contamination, odor and taste on milk, meat and eggs from animals fed DPW have indicated that they are acceptable for human consumption. (Merryman-East Central).

## 1870-A11, E3

### EVALUATION OF POULTRY MANURE AS A FEED INGREDIENT

Department of Poultry Science
Texas A&M University
College Station

J. R. Couch
Proceedings and Abstracts, XV World's Poultry Congress & Exposition, New Orleans, Louisiana, August 11-16, 1974, p. 231. 24 ref.

Descriptors: Poultry, *Excreta, Performance.
Identifiers: *Dried poultry waste, *Refeeding.

An intensive interest has developed toward using DPW from caged layers in feeds for chicks, laying hens and turkeys. Dried poultry waste is defined by the Association of American Feed Control Officials as "a product composed of freshly collected feces from commercial laying or broiler flocks not receiving medicants . . . thermally dehydrated to a moisture content of not more than 15 percent. It shall not contain any substances at harmful levels. It shall be free of extraneous materials . . . The product shall be labeled to show the minimum percent fiber. It may be used as an ingredient in sheep, lamb, beef and dairy cattle, broiler and layer chick feeds. Broiler and layer rations shall be limited to 20 and 25 percent DPW respectively. DPW has been fed to chicks and broilers, laying hens, and turkeys with the following results. (1) Chicks and broilers—They can tolerate 5 percent DPW with little effect on growth and feed conversion. Weights and feed conversion are depressed as the level of DPW is increased up to 20 percent. Increase of DPW causes an increase of feed intake and fecal volume. Uric acid in the DPW causes an increase of feed intake and fecal volume. Uric acid in the DPW cannot be utilized by a chick and may even be toxic. ((2) Laying hens—DPW can be used at levels of 22.5-25 percent without adversely affecting egg production or feed conversion. Increase of DPW causes increase of feed intake and fecal volume. (3) Growing turkeys have been fed DPW at levels of 5, 10, and 30 percent, 9-17 weeks, inclusive, without significant effect on weight gain but with an adverse effect on feed conversion as the level of DPW was increased. (Merryman-East Central).

### 1871-A6, A7, B2, B3, D3
### THE USE OF DRIED BACTERIA CULTURES AND ENZYMES TO CONTROL ODORS AND DECOMPOSE ORGANIC WASTES FOUND IN POULTRY PRODUCING UNITS AND PROCESSING PLANTS
Development, Big Dutchman, A Division of United States Industries, Inc.
Zeeland, Michigan
J. F. Bergdoll
Proceedings and Abstracts, XV World's Poultry Congress & Exposition, New Orleans, Louisiana, August, 11-16, 1974, p. 233-235.

Descriptors: *Bacteria, *Enzymes, *Odor control, *Organic wastes, *Waste treatment.
Identifiers: *Poultry houses, Poultry processing plants, *Poultry rendering plants.

Extensive work was done using dried bacteria cultures and enzymes to control ammonia and other odors produced by laying hens. Work was also done with waste from poultry processing plants and poultry by-product rendering plants. After much experimentation a bacteria product was standardized which was primarily composed of the following, per gram: 4 billion aerobic bacteria, 1.5 billion anaerobes, 15,000 casein digested units Protease, 190,000 starch liquefying units Amylase, 80 olive oil units, or (8TAU) Lipase. The strains were basically Bacillus subtilis and Asperigillus oryzae. In addition, there were small quantities of buffers, additional fermentation accelerating enzymes, organic surfactants, anti-foaming agents, calcium carbonate, sodium bicarbonate, U.S.P. pine oil and several natural oxidating agents. The additives were varied slightly, depending on whether the product was used to liquefy manure in a pit or used on manure under a cage. Several tests were conducted which used the product to control odor, to reduce volume of organic waste, to liquefy wastes, and to remove fat and buildup of blood in drain lines. In all cases, the product gave satisfactory results. It was found that odors and harmful gases can be reduced in poultry houses, poultry processing plants, and poultry rendering plants by the proper use of the bacteria product. The total volume of manure can be reduced from one-third to one-half. Fly control was an added boon. In all cases, the operator and caretakers felt that working conditions were vastly improved by use of the product. (Merryman-East Central).

### 1872-A4, A5, A8, B1
### AGRICULTURE: THE SEEDS OF A PROBLEM
Editor
Biomedical News
W. E. Small
Technology Review, Vol. 73, No. 6, p. 48-53, April, 1971. 4 fig.

Descriptors: *Agriculture, *Farm wastes, *Forestry, *Waste disposal.
Identifiers: *Land disposal, Pollution.

Farming and forestry produce more waste and contamination in the United States than do cities. Livestock and poultry waste is estimated at 1.7 billion tons annually. Biological wastes that were formerly recycled now accumulate, presenting greater disposal problems. Farmers generally ignore the value of organic fertilizers due to high labor and equipment costs. Groundwater pollution caused by disposal of livestock and poultry waste may effect changes in taste, odor, and color of the water. Manure treatment may increase nitrate levels in adjacent water supplies. Forestry leaves 25 million tons of debris each year, some of it beneficial, some of it a fire hazard or breeding place for disease and pests. The cities are turning to the farms for help with disposal of urban wastes. Various recycling schemes have been advanced to get valuable solid wastes back into the soil. Solids removed as sludge from domestic waste waters can be used for spreader application after treatment. Digested sludge is applied to agricultural lands as a liquid with less than 10 percent of solids. If applied at the rate of 2 in. per acre, it will supply over 500 lb. nitrogen, 200 to 300 lb. phosphorus and 40 to 80 lbs. potassium. The effects of long-term continuous applications are still under study. (Solid Waste Information Retrieval System).

### 1873-B2, B5, D2, D3
### DEVELOPMENT AND DEMONSTRATION OF NUTRIENT REMOVAL FROM ANIMAL WASTES
Agricultural Waste Management Program
Cornell University
Ithaca, New York
R. C. Loehr, T. B. X. Prakasam, E. G. Srinath, and Y. D. Joo.
Environmental Protection Agency Report Number, EPA-R2-73-095, January, 1973, 340 p. 100 fig, 41 tab, 194 ref.

Descriptors: *Nitrogen control, *Phosphorus control, Nitrification, Denitrification, Ammonia stripping, Chemical precipitation, Predictive relationships, Animal wastes.
Identifiers: *Nutrient control, *Animal waste treatment processes.

Laboratory and pilot plant studies evaluated the feasibility of (a) chemical precipitation, (b) ammonia removal by aeration, and (c) nitrification and denitrification as methods to remove nitrogen, phosphorus, and color from animal wastewaters. Poultry and dairy manure solutions were used over a broad concentration range to illustrate the fundamentals of the processes as applied to these wastes and to demonstrate the fundamentals of the processes as applied to these wastes and to demonstrate the applicability of the processes. Alum, lime, and ferric chloride can be used for phosphorus control in animal wastewater although the chemical costs are from 2-10 times those quoted for municipal wastewater. Two predictive relationships were determined that appear useful for design and operation of phosphate were developed and verified to determine the ammonia loss under specific environmental conditions. Nitrification followed by denitrification was found to be technically feasible. Parameters affecting the design and performance of these processes with animal wastewater were identified. (Loehr-Cornell).

### 1874-A11, C2, E3, F4
### RECYCLING ANIMAL WASTES AS PROTEIN SOURCES
L. W. Smith
Alternative Sources of Protein for Animal Production, Proceedings of a Symposium, Virginia Polytechnic Institute and State University, Blacksburg, July 31, 1972, p. 146-173, 2 fig, 5 tab.

Descriptors: *Recycling, *Animal wastes, *Proteins, Nitrogen compounds, Diets.
Identifiers: *Refeeding.

The purpose of this literature review was to discuss the use of animal wastes as a protein source of various kinds of farm animals as related to the diversity of nitrogen compounds in animal wastes and to discuss some animal recycling systems for efficient utilization. It was concluded that animal waste nitrogen is utilized when fed in livestock diets. Ruminants seem to utilize animal waste nitrogen better than other species. Caged poultry droppings appear to be the most suitable for recycling to ruminants. The author feels that technological advance will probably result in physical and fermentative advance for conversion of animal waste nitrogen into products of even higher nutritive value for livestock feeding. (Merryman-East Central).

### 1875-A11, C2
### AMMONIA TOXICITY LEVELS AND NITRATE TOLERANCE FOR CHANNEL CATFISH (ICTALURUS PUNCTATUS)
Caterpillar Tractor Co.
Peoria, Illinois
G. L. Knepp, and G. F. Arkin,
Presented at the 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-537, p. 2 fig, 1 tab, 7 ref.

Descriptors: *Channel catfish, *Ammonia, *Toxicity, *Bass, *Nitrates, *Fish farming, Resistance, Water pollution sources, Commercial fish, Fish management, Lethal limit, Bioassay, Filters, Filtration, Water purification, Water quality, Behavior, Fish toxins.
Identifiers: *Ictalurus punctatus, *Micropterus salmoides,· LC50.

Ammonia toxicity levels and nitrate tolerance are important factors in effective channel catfish farming. The results of this investigation indicate that the LC100 value for total ammonia is 43.7 and the LC50 is 37.5 ppm. Observations of nitrate concentrations for channel catfish and large mouth bass (Micropterus salmoides) indicate tolerance as high as 400 ppm. First symptom levels, such as the concentration values of total ammonia when fish go off feed (30 ppm) are seemingly more important to closed-system fish farmers. Recovery from higher levels than this indicate tolerance for short periods of time. (Katz).

### 1876-A2, B2, D3
### FEASIBILITY OF OVERLAND-FLOW TREATMENT OF FEEDLOT RUNOFF
Robert S. Kerr Environmental Research Laboratory
Post Office Box 1198
Ada, Oklahoma
R. E. Thomas
Environmental Protection Agency Report No. EPA-660/274-062, December, 1974, 29 p. 1 fig, 12 tab, 8 ref.

Descriptors: *Agricultural runoff, *Feedlots, Agricultural wastes, Waste treatment, Nitrogen cycle, Phosphorus cycle, Lagoons.
Identifiers: Overland flow, Loading rates.

This report covers six months of pilot-scale experiments and six months of data collection at one field experiment. The pilot-scale studies were conducted on plots which were 6-feet by 30-feet with a 4.5 percent slope. These studies indicated that: (1). loadings of 2 to 3 inches per week were suitable for field testing, (2) the weekly load should be applied in fractional increments at daily to three times per week frequencies, and (3) instantaneous spray rates should be less than 0.10 inch per hour. The field studies covered in this report were initiated at 12,000-head capacity feedlot and utilized a four-component train for runoff collection and treatment. The treatment train included collection lagoons, a storage reservoir, the overland-flow area, and a final polishing pond. Data from the short period of operation (six months) corroborated the results of the pilot-scale study and indicated that inclusion of the final polishing pond substantially improved the overall performance. R. E. (Thomas).

## 1877-B1

### AN EXPERIMENTAL ANALYSIS OF STRAIN AND DEFLECTION IN GRIDWORK PANELS FOR FLOOR SYSTEMS FOR LIVESTOCK

Oklahoma State University
G. L. Pratt
Ph.D. Thesis, Department of Agricultural Engineering, Oklahoma State University, Stillwater, 1967, 167 p. 37 fig. 39 tab, 23 ref.

Descriptors: *Livestock, *Design procedures, *Equations.
Identifiers: *Gridwork system, *Perforated floors.

The problem considered in the investigation was the evaluation of design procedures to be used for a gridwork system suitable for perforated floors for livestock. The objectives of the work were to determine if a prediction equation could be developed from data collected in a series of tests using grid models; and to validate existing design procedures by using the prediction equations that might be developed. Design data was given in detail. It was found that prediction equations gave useful information in developing or validating design. (Cartmell-East Central)

## 1878-A8, B2, B3, D1, D2, D3, E2

### MAINE GUIDELINES FOR MANURE AND MANURE SLUDGE DISPOSAL ON LAND

Miscellaneous Report 142, The Life Sciences and Agricultural Experiment Station and the Cooperative Extension Service, University of Maine, Orono, 1972, 21 p. 2 fig. 11 tab.

Descriptors: *Manure, *Sludge, *Maine, Nitrogen, Lagoons, Irrigation, Landfills.
Identifiers: *Land spreading, Composting, Guidelines.

This standard is concerned with conditions for: (1) total recycling of nutrients through planned crop production; (2) disposing of excess manure on the land by spreading; (3) piling on the land; (4) bulk burying in landfill; (5) composting; (6) lagoon treatment with sludge and liquid disposal; (7) disposal by irrigation; and (8) dehydrated manure disposal. Maximum rate for spreading manure on land and for other methods were developed from the physical and chemical characteristics of each individual soil, and from the available knowledge of the movement of manure liquids and residues on and through each soil type. The limiting factor in determining application rate is the pounds of nitrogen per acre to be applied. An extensive table is given summarizing the permissable disposal practices and maximum manure application rates for several Maine soils. (McQuitty, Barber-University of Alberta).

## 1879-A2, A4, A5, B2, E2

### THE STOCKMAN'S ROLE IN WATER POLLUTION CONTROL

Agricultural Engineer
Cooperative Extension Service
Washington State University
E. H. Davis and H. A. Bunten.
Extension Circular 361, Washington State University, Pullman, August, 1970, 6 p. 18 fig.

Descriptors: *Water pollution control, *Legal aspects, Feedlots, Agricultural runoff, Lagoons, Fertilizers.
Identifiers: Land spreading.

Animals should be fenced away from streams or waterways. Runoff from feedlot surfaces and feed storage areas should be kept out of streams by dikes, culverts or other such diversion facilities. If lagoons are to be used to impound animal wastes, they should be lined with an impervious material to prevent seepage of effluent and should be protected with dikes in the event of floods. Equipment for applying animal wastes to fields was described. (McQuitty, Barber-University of Alberta).

## 1880-A5, B1, F4

### EFFECTS OF AGRICULTURAL PRACTICES ON AQUIFERS

Department of Biological and Agricultural Engineering
North Carolina State University
Raleigh
G. J. Kriz
Presented at the 1971 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 7-10, 1971, 18 p. 88 ref.

Descriptors: *Aquifers, *Effects, *Animal wastes,, Fertilizers, Pesticides, Bacteria, Viruses, Soils, Climates, Topography, Nitrates.
Identifiers: *Agricultural practices, *Groundwater pollution, Saline waste waters.

Literature published since 1969 is reviewed which concerns the effects of agricultural practices on aquifiers. One section is devoted specifically to animal wastes. On the basis of published research, it is reported that nitrate levels beneath feedlots usually decline markedly with depth, probably as a result of denitrification and the effect on infiltration of a manure packed cover. Some type of pollution is probably occurring beneath feedlots but how fast the pollutants are moving to the water table and how far they move in aquifers is not generally known. (McQuitty, Barber-University of Alberta).

## 1881-B2, D3, E2, E3

### A RECIRCULATING WASTE SYSTEM FOR SWINE UNITS

Department of Agricultural Engineering
Iowa State University
Ames, Iowa
J. R. Miner
Environmental Protection Agency Report EPA-670/2-73-025, July, 1973, 220 p. 41 fig. 118 tab, 88 ref.

Descriptors: *Swine, *Waste treatment, Ditch Lagoons, Biochemical oxygen demand, Waste water, Soil water percolation, Effluents, Drain tiles, Ammonia.
Identifiers: Swine wastes, *Oxidation ditch, *Irrigation disposal, *Solid waste management, Reuse, Chemical oxygen demand, Solids reduction, Manure hauling, Ditch pump, Flush tanks, Soil preparation.

The purpose of this project was to develop and characterize a swine manure management system. The goal of the system was to collect, transport, treat, reuse and dispose of the manure in such a way that it would be compatible with current confinement swine production systems, yet minimize both labor and pollution potential. Such a system was devised and evaluated. Its basis was to hydraulically flush manure from shallow dunging gutters with the treated wastewater. The treatment devices evaluated included an anaerobic lagoon and an oxidation ditch. Excess water from the system was applied under controlled observation to adjacent cropland using conventional sprinkler irrigation equipment. The overall validity of this concept was proven. (Miner).

## 1882-A4, A8, B1, E1, E2

### RELATING AGRICULTURAL INSTRUCTION TO ENVIRONMENT IMPROVEMENT: THE ROLE OF LAND AND SOIL

Agricultural Chemistry and Soils Department
Arizona University
Tucson
W. H. Fuller
Journal Paper No. 1854 of the Arizona Agricultural Experiment Station, University of Arizona, 1971, p. 69-72. 4 fig. 1 ref.

Descriptors: *Soils, *Waste disposal, *Oceans, *Water pollution, *Soil contamination, Fertilizers, Soil conservation, Organic matter, Carbon dioxide, Bacteria, Nutrients, Municipal wastes, Nitrogen, Phosphorus, Sulfur, Farm wastes.
Identifiers: *Agricultural instruction, *Land disposal, *Manure, Transformation.

For many years people have warned the government and other people that man's waste disposal problem should be controlled before it gets out of hand. In the past these warnings were ignored, but today many people are waking up and working to slow down the pollution of our environment. Pollution usually ends up in either the soil or ocean. Resistance to polluting the ocean has thrown most of the burden of waste disposal on the soil. Pollution can be controlled through the soil because it is an excellent digester of wastes. The soil decomposes organic matter. It produces nitrogen and sulfur through complex microbial cycles which are initiated by organic material, and the end product of most waste is carbon dioxide, water, and humus. What is needed is knowledge of how to use these wastes to benefit the soil, and this should begin in the colleges. Courses should be developed to make people aware of the problems and the solutions. (Russell-East Central).

## 1883-B2, B4, E2, F1

### CUSTOM CATTLE FEEDING MOVES TO THE SOUTHEAST

B. Johnson
Progressive Farmer, Vol. 89, No. 4, p. 96, April, 1974, 1 fig.

Descriptors: *Cattle, *Southeast U.S., *Waste disposal, Costs, Feedlots.
Identifiers: Feeding, Land disposal

Custom cattle feeding in the Southeast, concrete feedlot flush system, and reconstituted high-moisture corn are a few of the special features of the new Walworth Farms Feedlot in Eutawville, South Carolina. To solve the high rainfall and mud problems, Walworth has installed a flush system made by AGPRO, Inc., to remove manure daily. All 40 lots are paved with concrete and can be flushed by pumping water into a reservoir and releasing it to run across the pens. After this water flushes the lots, it then goes into a large holding tank from which it is pumped onto the land to be used for growing silage. (Cameron-East Central).

## 1884-A1, B3, F1, F6

### THE COWS VS. THE SUBURBS

College of Engineering
Washington State University
Pullman
D. C. Flaherty

Quest, Vol. 6, No. 1, p. 1-7, March, 1968. 10 fig.

Descriptors: *Dairy industry, Costs, Research and Development, Water pollution, Social aspects, Lagoons, Grants.
Identifiers: Land spreading.

The problem of cow-suburb co-existence, although common in many parts of the United States, is becoming especially acute in certain areas of western Washington. Not only is there an aesthetic problem, but even more critical is the potential water pollution problem. To prove the belief that cows and surburbs can exist together, an extensive research project was begun last May with Dr. Donald E. Proctor, a Research Division sanitary engineer, as the chief investigator. The study is primarily being carried out at the Monroe Reformatory Honor Dairy Farm. Because of flooding problems, Dr. Proctor asked for a Solid Waste Disposal Demonstration Grant. It is anticipated that after the end of the three-year study, the Monroe project facilities will remain in operation. The project facilities will continue to be available for inspection by anyone interested in dairy management. Also, all operating data and evaluation reports will be available for study by interested individuals or agencies. (Cameron-East Central).

## 1885-B1, C1, C2, C3, E3, F2

### CALIFORNIA ISSUES DPW REGULATIONS

Poultry Digest, Vol. 33, No. 387, p. 197, May 1974.

Descriptors: *Regulation
Identifiers: *Dried animal wastes, License, Processing, Requirements, California Department of Food and Agriculture.

On April 10, 1974, the California Department of Food and Agriculture released proposed licensing and processing requirements for dried animal wastes products within the state. Anyone producing dried animal waste products must have a commercial feed license. The applicant must submit a description of the facilities equipment and processing procedures. If satisfied, the Department director will issue an endorsement to the commercial feed license. The director may require use of recording devices, thermometers, periodic sampling and laboratory examination, and such other records as he may deem necessary. Under the general provisions, dried animal wastes are defined as a processed product composed of total excreta—with or without litter from poultry or ruminant animals. The final product cannot exceed 12 percent moisture and must be free of pesticides and drug residues and also free of pathogens. The product shall not be fed for 15 days prior to slaughter. Specific animal waste products—dried poultry waste, dried poultry litter, and dried ruminant waste—are described. (Cameron-East Central)

## 1886-A2, A10, A11, B1, B4, B5

### SLOTTED-FLOOR COLD-CONFINEMENT BEEF CATTLE HOUSING

Agricultural Engineering Department
Illinois University
Urbana—Champaign
D. G. Jedele and F. W. Andrew
Presented at the Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, 18 p. 22 fig, 1 tab.

Descriptors: *Cattle, *Design, Performance.
Identifiers: *Slotted floors, *Cold confinement, *Housing, Waste management.

Slotted-floor cold-confinement systems for finishing feeder cattle have one side open except for a fence which keeps the cattle inside. Inside temperature fluctuates according to outside temperature. No bedding is used. Manure falls through the slotted floor to the storage tank below. Nine advantages of such a system are: (1) Surface runoff is practically eliminated, (2) Slotted floors eliminate the cost of bedding and the labor for spreading value. (3) Protection from sun and rain maintains the fertilizer value. (4) Less labor is needed to handle manure, (5) Flies are reduced. (6) Cattle are more docile and easier to handle when sorted or treated. (7) Cattle are usually clean and seem to be favored by packers because of a 1 to 2 percent better yield. (8) The herdsman can do a better job of observing cattle, especially during bad weather. (9) Less land is needed, and the site development is easier. Design recommendations are given. (Merryman-East Central)

## 1887-A8, B2, B3, C2, E2

### ALL OF A SUDDEN MANURE DOESN'T SMELL SO BAD ANYMORE

Extension Agronomist
Pennslyvania State University
W. W. Hinish
Crops and Soils Magazine, Vol. 277, No. 3, p. 12-15, December, 1974. 3 fig. 1 tab.

Descriptors: *Animal wastes, *Fertilizers, *Nutrients.
Identifiers: Land disposal, Application rates.

Animal wastes are once more being considered as fertilizers because of the rising cost and scarcity of commercial fertilizers. The nutrient value of farm wastes is high. They contain primarily nitrogen, phosphorus and potassium. Half the nitrogen and two thirds of the potassium is in liquid form. Almost all the phosphorus is in solid form, Improper storage and leaching can result in losses of the liquid nutrients. Proper handling such as application at low rates just before plowing increase the nutrient benefits. Nutrients in the solid form must decompose. Therefore, about half the nitrogen content of cattle and swine wastes is not considered available the year of application. But all the nitrogen of poultry wastes is considered available the year it is applied. (Kehl-East Central)

## 1888-A8, B3, E2

### BEEF FEEDLOT MANURE AND SOIL WATER MOVEMENT

Associate Professor
Agricultural Engineering Department
Kansas State University
Manhattan
H. L. Manges, D. E. Eisenhauer, R. D. Stritzke, E. H. Goering.
Presented at the 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 10 p. 1 fig, 1 tab, 5 ref.

Descriptors: *Equations, Soils, Feedlots.
Identifiers: *Manure, *Water intaake rates, *Application rates.

Feedlot manure from the 33,000 head capacity Pratt Feedlot, Inc., located 10 kilometers north of Pratt, Kansas, was applied to Farnum loam soil annually at rates ranging from 0 to 977 metric tons dry matter per hectare to determine the effects of feedlot manure application rates on the basic water intake rate, Feedlot manure was also applied to another area at rates ranging from 0 to 589 metric tons of dry matter per hectare. This area received no manure in subsequent years. Multiple regression equations were developed to predict basic intake rates from annual application rates. Basic intake rate gradually decreased as manure application rate increased during the first year. During subsequent years, basic intake rate increased as manure application rate increased up to 93 to 269 metric tons dry matter per hectare annually and decreased as manure application rate continued to increase. (Battles-East Central)

## 1889-A4, A5, A6, A7, A8, B1, F1

### AGRICULTURAL ANIMALS AND THE ENVIRONMENT

Illinois College
Jacksonville
R. Graber
Feedlot Waste Management Regional Extension Project, Oklahoma State University, Stillwater, July, 1974, 55 p. 17 fig, 6 tab, 39 ref.

Descriptors: *Feedlots, Management, Air pollution, Water pollution, Groundwater pollution, Anaerobic treatment, Lagoons, Fertilizers, Climatology, Agricultural runoff, Costs.

A demand for animal products and meats has resulted in a concentration of animals in confined areas. Animal wastes, a by-product of the meat industry, cause undesirable environmental modifications. Such modifications can be minimized by proper management practices and site selection. Although groundwater appears to be relatively unaffected by active feedlots, surface waters need to be protected. The soil used for feed production to run the feedlot is capable of safely assimilating the animal wastes produced by the lot. Feedlot odor production is a function of both management and climate. Gas dispersion is dependent primarily on wind speed and mixing height. Economic parameters favor the location of large facilities in the same general area where climatic conditions are most favorable. (Kehl-East Central)

## 1890-A2, C1, C2, D3

### LABORATORY STUDIES ON FEEDLOT RUNOFF

Department of Civil Engineering
Nebraska University
L. R, Christensen
MS Thesis, Department of Civil Engineering, Nebraska University, April, 1973, 77 p. 16 fig. 15 tab, 40 ref.

Descriptors: Animal wastes, Agricultural runoff, Feedlot runoff, Waste treatment, Feedlot wastes, Coagulation.

Laboratory studies, beginning in mid-September, 1971, and continuing through the summer of 1972, were made to determine the optimum operating conditions for an extended aeration system with air lift solids return. Treatment efficiencies were evaluated at relative equilibria of the monitoring parameters of MLSS, effluent SS, mixed liquor COD, effluent COD, and soluable effluent COD with respect to the influent waste COD and SS. Results of the study showed that aerobic treatment with a forced solids return could operate at greater than 30 percent efficiency for both solids and COD removal at detention times as low as 2 days without additional treatment. It was concluded that feedlot runoff is amenable to aerobic treatment. (Cameron-East Central)

## 1891-A2, A6, A10, B2, D1, D3, E2, F1

### WASTE TREATMENT SYSTEM FOR CONFINED HOG RAISING OPERATIONS

Midwest Research Institute
Kansas City, Missouri
W. E. Park
Environmental Protection Agency Report No. EPA-660/2-74-047, May, 1974, 73 p. 34 fig. 4 tab.

Descriptors: Swine, Waste treatment, Aeration, Settling pond.
Identifiers: Odor control, Economics, Surface aerators, Flushing gutters, Aerobic digestion.

A waste treatment system was installed in conjunction with an existing confined swine feeding operation at Schuster Farms, Gower, Missouri. The system consisted of a concrete aeration tank equipped with mechanical surface aerators, followed by a settling pond. Wastes from the 1,000-hog feeding operation were flushed through a gutter in the concrete feeding floor into the aeration tank, where they were aerobically digested. All aeration tank discharges were retained in the settling pond where the liquids evaporated. The waste treatment facility operated continuously and dependably over a 2-year period, with treatment efficiency averaging 90 percent to 95 percent. The system effectively controlled objectionable odors and insects, contained all liquid runoff emanating from the feeding operation, and left only a dry, inert residue suitable for land disposal. Installation cost for the system was $12,000. Net operating costs, including amortization of capital costs, were $7.33 per day. Thus, total environmental control was achieved at a cost of approximately $1.00 per hog, or 1/2 cent per pound (1.1 cent per kilogram) of weight gained while on the feeding floor. (Water Resources Scientific Information Center)

### 1892-A1, A8, B2, B4, D3
### IMPLEMENTING THE MISSOURI APPROACH TO SWINE WASTE MANAGEMENT IN NORTHEAST MISSOURI
Area Agricultural Engineering Specialist
Kahoka, Missouri
J. A. Hoehne and R. M. George
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, 4 p. 1 ref.

Descriptors: *Design, *Missouri, *Confinement pens, *Pollution abatement, Evaluation, Agricultural runoff.
Identifiers: Waste management, *Swine, *Storage basins, *Anaerobic lagoons, *Soil-plant filters, Missouri Approach, Slotted floors.

The design and implementation of animal waste management systems using the basic concepts set forth in the "Missouri Approach" to Animal Waste Management is reviewed. The basic components of swine waste management systems in Northeast Missouri are concrete detention basins, anaerobic lagoons, and soil-plant filters. The waste management systems formed by combinations of these components are evaluated. The design, implementation and management of these waste management systems appear to have many practical applications. (Cartmell-East Central)

### 1893-A5, A8, B3, C2, C3, E2
### LAND DISPOSAL OF POULTRY MANURE IN RELATION TO SOIL WATER QUALITY AND SILAGE CORN YIELD
Connecticut University
Storrs
R. W. Wengel and J. J. Kolega
Presented at the 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, December 11-15, 1972, 31 p. 2 fig, 16 tab, 7 ref.

Descriptors: *Poultry, *Water quality, *Lysimeters, Nitrates, Chlorides, Soil microorganisms.
Identifiers: *Land disposal, *Yields, Application rates.

A field lysimeter study was conducted concerning the effects of high poultry manure application rates on corn silage production as it relates to crop and soil water quality. The findings indicated that for normal soil conditions, the soil was effectively filtering out microorganisms for the two and one-half foot depth. In general nitrate and chloride concentration in all lysimeters were high during those years when manure was applied. The high rate of application resulted in higher concentrations of nitrate and chloride. The soil water coming from the manured plots had a greater degree of acidity. The average COD concentrations of the soil water for any drain was less than 100 mg/1. Crop yields were inversely related to manure application rates. Of the measurements made, the nitrate ion is the most critical parameter in establishing the maximum application rates for manure. (Cartmell-East Central)

### 1894-A1, B1, B4
### HEAT AND MOISTURE PRODUCTION FROM A BEEF BUILDING INCLUDING MANURE TANKS
Confinement Engineer
Morton Buildings
Spencer, Iowa
M. A. Hellickson, H. G. Young and W. B. Witmer
Transactions of the ASAE, Vol. 17, No. 3, p. 533-535, May-June, 1974. 4 fig, 5 ref.

Descriptors: *Design, *Heat, *Moisture, *Storage tanks, *Sensible heat, *Latent heat, *Cattle.
Identifiers: *Confinement building.

A study was established in order to determine (1) total heat and moisture production from a closed confinement beef building under actual production conditions, (2) sensible and latent heat production from a closed confinement beef building, and (3) heat and moisture contributions to the environment from the manure storage tank located under the slotted floor. These data are essential for proper design of livestock structures and environmental control systems. The following data were collected. Average daily total, sensible, and latent heat production from a building housing 47 head of 530 to 640-lb. Hereford steers averaged 2870, and 2180 Btu per hr. per head, respectively. The effect of the manure storage tank located under the slotted floors was to add an average of 205 Btu per hr. per head of latent heat and the remove 175 Btu per hr. per head of sensible heat from the animal environment. It was determined that latent heat production in a confinement beef building decreases with increases of relative humidity and animal density. Latent heat increases with increasing temperature. Sensible heat, however, decreases with temperature increase and increases with relative humidity increase. (Cartmell-East Central)

### 1895-A4, A5, B1, C2, E2
### AGRICULTURAL WASTES AND GROUND WATER QUALITY
California University
Davis
R. S. Ayers
Proceedings of 9th Biennial Conference on Ground water, September 13-14, 1973, Francisco Torres Conference Center, Goleta, California; California University Water Resources Center Report No. 26, p. 94-96, December, 1973.

Descriptors: *Water pollution sources, *Farm wastes, *California, Leaching, Fertilizers Groundwater, Water pollution control.

Irrigated agriculture's waste products include salts concentrated by evapotranspiration, residues of fertilizers and soil amendments not picked up by crops, and animal manures from dairy and feed lots. The contamination can be minimized by establishing a favorable balance where export of pollutants balances import, and at a sufficiently low level of pollutant that beneficial uses are not affected. (Knapp-USGS)

### 1896-A4, C2, F3
### WATER QUALITY AND WASTE DISPOSAL IN MONTANA
Department of Botany and Microbiology,
Montana State University
Bozeman
J. W. Jutila
Montana Agriculture — Focus on Improving the Environment, December 3-4, 1970, p. 61-68. 1 fig. 2 tab.

Descriptors: *Water quality, *Waste disposal, *Montana, *Water pollution, *Eutrophication, Nitrates, Phosphates.

Many Montana rivers and streams are being polluted with human and agricultural wastes, even at their headwaters, to the extent that the quality of water of the Missouri River along its entire length may be seriously compromised. Surface waters are becoming so fertilized by man's activities that objectionable growths of water flora appear in abundance. In 1957, several teams of investigators from the Montana State University investigated the nature of the pollution problem in the East Gallatin River and its tributaries. Phosphates and nitrates coming from sanitary sewer systems, synthetic detergents, burial of solid wastes, and excreta of farm animals, were found to be the primary factors causing undesirable water changes. Federal and state agencies have sponsored studies on the problem and solution of agricultural and human waste disposal pollution, emphasizing water quality studies. But far more research is required on the identity, fate, and biological and non-biological transformation of these pollutants. (Hisle-East Central)

### 1897-B1, C2, E1
### CHICKEN MANURE, ITS PRODUCTION, VALUE, PRESERVATION, AND DISPOSITION
C. F. Eno

Descriptors: *Poultry, *Chemical properties, *Nutrients, *Preservation, *Disinfection, *Waste disposal, Dehydration, Leaching, Economics.
Identifiers: *Manure, Composting.

Poultry waste is a good source of plant nutrients. Factors affecting poultry waste production rates are age, breed of chickens, and amount and kind of feed and water consumption. Poultry waste contains such major fertilizer constituents as nitrogen (N), phosphorus (P205) and potassium (K20). Since the vast majority of poultry waste is not used as produced, aging causes many compositional changes. Poultry waste composition is also influenced by the kind and amount of litter. Nutrient availability is related to the form in which the elements occur. Fresh poultry waste may contain nutrients in both organic and inorganic form. In many older accumulations, leaching of inorganic fractions results in a low nutrient content and low availability. Leaching of soluble compounds (primarily salts) and volatilization are the primary routes by which nutrients are lost. Methods of preservation and disinfection are given. Methods of poultry waste disposal and management are also discussed. (Kehl-East Central)

### 1898-B2, D2, D3
### ANIMAL WASTE DISPOSAL
Feedstuffs, Vol. 43, August, 1971, p. 30.

Descriptors: *Animal wastes, *Waste disposal, *Canada, Aerobic treatment, Lagoons, Chlorination Effluent.
Identifiers: Anaerobic treatment.

The National Hog Center discharges animal waste into the Fraser River in British Columbia. A University of British Columbia team reported that the National Hog Center is about the only example in the area of a company attempting to control pollution. The National Hog treats its effluent with a system which includes two primary lagoons and one secondary lagoon. Much of the time, chlorination is also used. This results in an effluent with a BOD rating well under the specifications of their Pollution Control Board License. Proposed changes to make the system more satisfactory and applicable to other areas were listed. (Kehl-East Central)

### 1899-A5, A8, B2, B3, C2, E2
### NITROGEN LOAD OF SOIL IN GROUND WATER FROM DAIRY MANURE
Department of Soil Science and Agricultural Engineering

California University
Riverside
D. C. Adriano, P. F. Pratt, S E. Bishop, W. Brock, J. C. Oliver and W. Fairbank
California Agriculture, Vol. 25, No. 12, p. 12, December, 1971. 4 fig.

Descriptors: *Nitrogen compounds, *Dairy industry, *Salts, *Sampling.
Identifiers: *Land disposal, *Application rates, *Groundwater pollution, *Soil contamination.

Nine sites for each of the following categories were drilled with power driven augers in the Chino-Corona dairy area of California: (a) two sites with no manure or irrigation water applied, (b) six acres of irrigated cropland for disposal of barnyard and/or liquid manure, (c) five irrigated pasture sites for disposal of wastes from milking operations, and (d) two corral sites where manures were generally scraped twice yearly and discharged to croplands and pastures. Samples were collected and analyzed for ammonium-nitrogen (NH-N), nitrate-nitrogen (NO2-N), and nitrate-nitrogen (NO3-N). Water from the water tables was sampled for NO3 and total salt analysis. Comparison was made of water from adjacent domestic wells. NO3-N concentration was highest under the corrals, followed by the pastures, then the croplands, and then the controls. While NO3 concentrations in deep wells were considerably lower than those of shallow wells, the NO3 concentrations of deep wells exceeded the PHS standard of 45 parts per million NO3. Thus dairy manure disposal to croplands and pastures is hazardous to ground water. If high rates of manure disposal are to continue in this area, research is needed on: (1) recycling nitrogen and other nutrients under local conditions in order to establish application rates, (8) removing slats and nitrogen so that disposal amount can be increased, and (3) development of alternatives to land disposal of manure. (Merryman-East Central)

## 1900-D2, E3

### CONVERSION OF CATTLE FEEDLOT WASTES TO AMMONIA SYNTHESIS GAS

Texas Tech University, Lubbock 79409
J. E. Halligan, K. L. Herzog, H. W. Parker, and R. M. Sweazy.
Environmental Protection Agency Report No. EPA-660/2-47-74-090, December, 46 p. 7 fig. 5 tab. 38 ref.

Descriptors: *Cattle, *Feedlots, Gases, Equipment.
Identifiers: *Fluidized bed reactor, Anhydrous ammonia, Synthesis gas.

A study was undertaken to determine the potential of a process to convert cattle feedlot manure to anhydrous ammonia. Due to the fact that ammonia is currently produced on a large scale using natural gas and air, only the processing associated with a reactor system to convert the manure into a suitable synthesis gas was considered in this study. The synthesis gas can be further processed to anhydrous ammonia using existing technology. (Halligan-Texas Tech)

## 1901-B2, B3, E2, E3, F4, F5

### FACTORS WHICH INFLUENCE THE UTILIZATION OF ANIMAL EXCRETA EITHER DIRECTLY BY ANIMALS OR INDIRECTLY THROUGH PLANTS

L. J. Fisher
Unnumbered paper, Canadian Society of Animal Science, Ottawa, Ontario, 15 p. 4 tab, 21 ref.

Descriptors: *Recycling, *Hydroponics.
Identifiers: *Manure, *Land disposal, *Refeeding

A literature review is presented concerning three methods for recycling animal manures: (1) recycling into the crop production system by field application of manure; (2) recycling of manure by hydroponic growth of algae, bacteria, yeast, cereals, and/or grasses; and (3) recycling by direct refeeding of manure to animals. The author concluded that hydroponics and integrated cropping systems are efficient methods for utilization of manure. Direct recycling of poultry manure through ruminants may have potential worth developing. (McQuitty, Barber-University of Alberta)

## 1902-A10, B3, C2, D3

### WINTER HIGH RATE COMPOSTING OF BROILER MANURE

Department of Environmental Biology
Guelph University
Guelph, Ontario
R. G. Bell and J. Poe.
Canadian Agricultural Engineering, Vol. 13, No. 2, p. 60-64, December, 1971. 10 fig. 2 tab, 5 ref.

Descriptors: *Winter, Aerobic conditions, Carbon, Nitrogen.
Identifiers: *Broilers, *Manure, *Composting.

A high-rate composter consisting of a reinforced concrete horizontal silo with an air distribution system incorporated into the floor was tested in Ontario in January. Freezing rain, sub-zero temperatures which required removal of frozen compost from the walls with chisels and crowbars and rodents which were "using the lower reaches of the composter as a 'centrally heated' home" caused difficulties. It was concluded, however, that (1) broiler manure can be composted outdoors in a Canadian winter without auxiliary heat, (2) a forced aeration system is essential for high-rate compositng of broiler manure, (3) loading should be daily (seven days per week), (4) the composter should be roofed to avoid excessive wetting of the contents by rain, and (5) the addition of a blending material, preferably ground garbage, to raise the carbon-to-nitrogen ratio well above its value of 14.3 for broiler manure would be advantageous. (Whetstone, Parker, Wells,—Texas Tech University)

## 1903-A11, C2, B3, C2, E3, F4, F5

### FEEDING VALUE OF ANIMAL WASTES

Animal Science Research Division
USDA, ARS
Beltsville, Maryiadn
L. W. Smith
Animal Waste Reuse—Nutritive Value and Potential Problems from Feed Additives—A Review, ARS 44-224, February 1971, p. 5-13, 1 tab.

Descriptors: *Feeds, *Ruminants, Algae, Cattle, Poultry, Hogs, Animal disease, Catfish, Waste treatment, Dehydration, Feasibility.
Identifiers: *Manure, *Literature review, Feeding value.

This paper reviews the literature concerned with feeding animal waste to livestock. Fiber in diets for ruminants is not digested to the maximum possible extent during the initial pass through the digestive tract. Other nutrients also escape digestion. Feeding feces is not a new concept. Early in the 1940's cow manure was looked upon as a source of B-complex vitamins. Poultry and catfish have been successfully fed rations containing feedlot manure. There have been many articles concerning the use of poultry litter in ruminant feeding programs. Feeding poultry feces to poultry was reported to have no adverse effect on bird mortality or egg taste. Algae grown on sewage has been fed to rats. The authors indicate that algae is a potentially valuable livestock feed. (Christenbury—Iowa State)

## 1904-A6, A7, B2, B3, C2

### ODORS AND GASES LIBERATED FROM DILUTED AND UNDILUTED CHICKEN MANURE

Cornell University
Ithaca, New York
D. C. Ludington, A. T. Sobel, and A. G. Hashimoto.
Transactions of the American Society of Agricultural Engineers, Vol. 14, No. 5, p. 855-859, September-October, 1971. 12 fig, 1 tab, 8 ref.

Descriptors: *Odor, *Gases, Poultry, Ammonia, Carbon dioxide, Hydrogen Sulfide.
Identifiers: *Manure, *Dilution

Investigation and comparison of the release of some gases and odors from stored chicken manure in both undiluted and diluted states is reported. Air was passed over the surface of manure in two containers, one for each system, at a flow rate of 1 standard cu. ft. per hr. This rate was checked daily with a wet-test meter. Container outlets were connected to a manifold from which the air was distributed to the carbon dioxide analyzer, to wet scrubbers for ammonia and hydrogen sulfide analysis, or to odor-strength measuring devices. White Leghorn laying hens provided the manure, which was added daily. Results of the study indicate that, with regard to production and release of gases and odors, significant differences occurred between undiluted and diluted manure. Undiluted manure released slightly greater amounts of carbon dioxide than diluted manure; the undiluted system likewise released more ammonia. Manure stored in a diluted state produced more hydrogen sulfide and ammonia than undiluted-state manure. Although both releases were below threshold, hydrogen sulfide release from the diluted system was twice that released from undiluted manure. Odor strength of animal manures can be measured by liquid dilution on a laboratory basis; odor strength of released gases can be measured by vapor-dilution methods. Diluted or 'liquid' manure produces odors with a strength comparable to odors arising from undiluted manure. The quality of 'liquid' manure odor is much more offensive than the ammonia odor from the undiluted system. (SWIRS)

## 1905-B2, B4, C2, D1, D3

### AEROBIC TREATMENT OF PIGGERY WASTE

School of Biological Science, University Sains Malaysia, Penang, Malaysia.
J. D, Owens, M. R. Evans, F. E. Thacker, R. Hissett, and S. Baines.
Water Research, Vol. 7, No. 12, p. 1745-1766, December, 1973. 11 fig. 7 tab, 15 ref.

Descriptors: *Aerobic treatment, Effluents, Suspended solids, Nitrification, Biochemical Oxygen demand, Sludge, Acidity, Alkalinity, Degradation.
Identifiers: *Swine.

Two main types of aerobic treatment systems operated at different loading rates and temperatures were studied: one with floc formation and gravity separation of liquid and solid effluents; and a second without floc formation or separation of the effluent into liquid and solid fractions. A mixed liquor concentration in the range 5.0-7-5g 1-1 appeared suitable to achieve liquid effluents having low suspended solids concentrations. The studied parameters most effected by loading rates at 15° C were (1) the properties of the liquid effluent; (2) the pH value of the mixed liquor; (3) nitrification; (4) the BOD5 of the supernatant from the mixed liquor; and (5) sludge production as a percentage of solids input. A sudden large increase in the loading rate can result in a complete breakdown of the biological process. At 15° C the mixed liquors were acidic or neutral at loadings below about 0.30 g SS g MLSS-1 d-1 while they were moderately alkaline at higher loading rates. Nitrification seemed to cause acidic conditions in the mixed liquors. In the absence of nitrification, the mixed liquors remained alkaline. The concentration of BOD5, the output of suspended solids, and the output of chemical oxygen demand in the supernatant from the mixed liquors increased with increasing loading rates. Nitrification was prevented at 5° but operation of treatment units at temperatures of 5° and 10° had little effect on the efficiency of degradation. At certain loading rates, operation at 25° C appeared to increase the amount of degradation compared with that achieved at 15° C.

## 1906-A11, C2, E3, F1

### PROCESSED MANURE SEEN AS PROTEIN OF FUTURE

Beef, Vol. 11, No. 1, p. 45, September, 1974

Descriptors: *Cattle, *Refeeding, Proteins, Costs, Performance
Identifiers: *Excreta

Protein from cattle excreta can be nutritionally beneficial in supplementing feedlot rations prior to the final month or two of finishing. The benefit from the protein in the excreta was seen in increased weight gains. Lower feed costs of gain is a favorable aspect of excreta-fed cattle when no charge is made for the excreta and processing of it through a silo. R. L. Vetter, animal scientist at Iowa State University, and his colleague, Wise Burroughs, found that as much as 50 percent of cattle excreta can be successfully recycled through feedlot cattle except for the final month or two prior to marketing. The scientists say more research is needed before results obtained in experiments thus far can be recommended in cattle feeding practice. (Cameron-East Central)

## 1907-D2, E3

### FEEDLOT MANURE AND OTHER AGRICULTURAL WASTES AS FUTURE MATERIAL AND ENERGY RESOURCES: II. PROCESS DESCRIPTIONS

Department of Chemical Engineering
Kansas State University
Manhattan
W. P. Walawender, L. T. Fan, C. R. Engler, and L. E. Erickson
Project Report No. 45, Department of Chemical Engineering, Kansas Agricultural Experiment Station, Manhattan, March 1, 1973, 31 p. 7 fig, 8 tab, 44 ref.

Descriptors: *Feedlots, *Energy, Design, Oil, Gases
Identifiers: *Manure, *Agricultural wastes, *Liquefaction, *Gasification, Hydrogasification

This report provides a description of three potential chemical processing schemes for the conversion of feedlot wastes to useful products. A liquefaction process for the production of an oil-like material was considered for processing 4,300 tons/day of wet manure. The oil product obtained amounts to approximately 4,330 barrels per day. Two gasification schemes were also considered. The first is a gasification to produce a synthetic gas. The synthesis gas plant processes about 1,100 tons/day of wet manure from which some 8 million standard cubic feet of gas is obtained. The second process is for hydrogasification of 1,000 tons/day of wet manure. The product is essentially pure methane in the amount of 6 million scf per day. (Walawender-Kansas State University)

## 1908-B2, C2, D3, E1

### A STATUS REPORT ON AGRICULTURAL AND MUNICIPAL WASTE TREATMENT LAGOONS IN MISSISSIPPI

Department of Agricultural and Biological Engineering
Mississippi Agricultural and Forestry Experiment Station
J. B. Allen and J. C. McWhorter
Presented at the 68th Annual Convention of the Association of Southern Agricultural Workers, Richmond, Virginia, February 14, 1972, 19 p. 2 fig, 8 tab, 4 ref.

Descriptors: *Municipal wastes, *Waste treatment, *Lagoons, *Mississippi, Effluent
Identifiers: *Agricultural wastes, *Status report, Bacteriological analysis, Chemical analysis

Results are given of a study to evaluate the current use of, and attitudes toward, lagoons as devices for waste treatment. It was reported that, at the time of a State survey, there were 216 municipal lagoon systems, covering 2,972.5 acres, and 241 animal waste treatment lagoons, of which 221 were used for swine, 16 for dairy, and 4 for poultry. The BOD of the municipal lagoon effluent varied from 18.0 to 79.5 mg/l compared to a range of BOD from 92 to 870 mg/l for agricultural waste treatment lagoons. Agricultural waste treatment lagoons have been readily accepted by farmers and the number of lagoons is expected to increase rapidly, partially because the federal government will cover 80 percent of the construction cost. (McQuitty, Barber-University of Alberta)

## 1909-B2, D3, E3

### COOKING WITH COW POWER

Popular Mechanics, Vol. 141, No. 3, p. 75, March, 1974, 3 fig.

Descriptors: *Methane, *Anaerobic bacteria, *Cattle, *Fertilizers, *Recycling, *Waste treatment, Slurries, Natural gas.
Identifiers: *Manure.

Dick Suttleworth, owner of a cattle farm at Red Key, Indiana, his son and a couple of expert consultants, built a prototype generator that converts cow manure and other waste materials into methane—natural gas—and a nitrogen-rich fertilizer. Manure is mixed with water to form a slurry. Anaerobic bacteria break down the solid matter to produce methane. The Suttleworth's have used home-brewed methane to run a variety of equipment: a gas lamp, a range, a gas refrigerator, a 1948 Chevrolet engine, and a space heater. It was estimated that the manure from 36 head of cattle would provide enough gas to heat the large Suttleworth farmhouse. (Cameron-East Central)

## 1910-B2, B5, C2, D1, D3

### SALTS CONCENTRATION IN A RECYCLING AEROBIC WASTE DISPOSAL SYSTEM

R. E. Smith and J. D. Jenkins
Transactions of the American Society of Agricultural Engineers, Vol. 14, No. 6, p. 1076-1078, 1971.

Descriptors: *Salts, *Recycling, *Biodegradation, *Aerobic treatment, Poultry, Biochemical oxygen demand, Effluent, Equations.
Identifiers: *Excreta

At the bio-engineering laboratory of the Agricultural Engineering Center at the University of Georgia, research was done to study the effects of salt concentrations on the biodegradation of poultry wastes. A recycling aerobic digestor was used to provide an effluent whose ionic spectrum was then determined. Synthetic effluents with similar ionic spectra were used in aerobic digestors to determine the effect on BOD and volatile solids reduction by the level of salts concentration. Tables show analyses of the actual effluent and the synthetic effluents. Mathematical equations for the processes used are given. It was found that there is little danger of adverse effects of salt concentration on microbial action in a recycling aerobic poultry-waste digestor because sludge removal will keep the concentration at an acceptable level. Salt buildup in this type of system has little effect on BOD reduction and volatile solids reduction up to a concentration of soluble nonvolatile solids of about 20,000 mg per liter of solution. A concentration of 250,000 mg per liter of solution of soluble nonvolatile solids impairs the BOD reduction rate significantly for the naturally occuring microbial populations used in this study. (Solid Waste Information Retrieval System)

## 1911-B2, D3, E3

### A CLOSED SYSTEM — NEW IDEA IN POULTRY WASTE DISPOSAL

D. W. Darden
Progressive Farmer, Vol. 89, No. 11, p. 42-43, November, 1974. 2 fig.

Descriptors: *Poultry, *Recycling.
Identifiers: *Excreta, *Anaerobic pond, *Aerobic pond, *Closed system.

Specialists and engineers at the Louisiana State University Cooperative Extension Service have developed a two-lagoon system that never has to be dumped. Chicken manure is flushed from pits beneath laying pens into an anaerobic pond for treatment. The water then flows into an aerobic pond for further bacterial digestion. Water is then pumped from the aerobic pond back to the laying houses where it once again flushes the pits under the laying pens. An adaptation of the system is being successfully used by a commercial operation just outside Hammond, Louisiana. Major advantages of this system are: no fly problem; reduction of labor, better working environment, no runoff, and adaptability of the system. (Battles-East Central)

## 1912-A6, B2, B5, C2, B3

### AERATION OF POULTRY WASTES FOR ODOR AND NITROGEN CONTROL

A. G. Hashimoto
Transactions of the ASAE, Vol. 17, No. 5, p. 978-982, Sept.-Oct., 1974. 6 fig, 2 tab, 9 ref.

Descriptors: *Poultry, *Aeration, *Nitrogen, *Biodegradation, *Slurries, Ammonia
Identifiers: *Odor control

This research was undertaken to study the effect of aeration rate on odor control and nitrogen removal in batch and daily fed systems. One to three day old manure from white leghorn laying hens was diluted one part manure to three parts distilled water. It was fed to reaction vessels in a daily fed study and batch fed study. The daily fed systems were started by pouring 4 liters of slurry into four separate vessels. Three vessels were stirred and aerated at rates of 1, 2, and 3 scfh/gal (Standard cubic feet of air per gallon of slurry). The final vessel was not aerated. The vessels were fed and sampled. The batch system was operated in a similar manner but manure was not added to the batch system after the start of the trial, and only two reaction vessels aerated at 2 scfh/gal were used. The study revealed that 15-20 percent of the total nitrogen is not readily biodegraded and may be termed recalcitrant. Carbon-nitrogen ratios of the recalcitrant nitrogen fraction were above 20 to 1, indicating little likelihood of mineralization when applied to soil. Odor offensiveness of laying-hen manure slurries decrease exponentially with aeration rate. Odors from batch aeration slurries progress from reduced gases characterized as 'sour,' 'fishy,' 'amines,' to predominantly ammonia odors as waste becomes stabilized. Dissolved oxygen levels between 1 to 2 mg/l must be maintained to achieve adequate odor control. (Battles-East Central).

## 1913-A6, A7, A11, B1

### EFFECT OF SLOTTED FLOORS ON AIR-FLOW CHARACTERISTICS IN A MODEL SWINE CONFINEMENT BUILDINGS

Cornell University
Ithaca, New York
D. D. Schulte, J. A. DeShazer, and C. N. Ifeadi
Transactions of the American Society of Agricultural Engineers, Vol. 15, No. 5, p. 947-956, 1972. 4 fig, 3 tab, 4 ref.

Descriptors: *Ventilation, *Model studies, *Confinement pens, Gases, Design
Identifiers: *Slotted floors, *Swine

A one-twelfth scale model of an existing swine confinement structure was used to determine the effects of various ventilation inlet and exhaust locations, baffle position, floor types and pit depth upon the air-flow characteristics within the building. Heater thermocouple anemometer readings were recorded and analyzed statistically to determine the effects of the different treatments. Iso-velocity lines were plotted to provide visual interpretation of the regions of high and low velocities. Turbulent intensities were calculated to determine the effectiveness of air mixing. Results showed that use of baffles to direct air along the ceiling in hopes of distributing the temperature and velocity more evenly through the building tended to increase air velocity and the significance of both the floor arrangement and pit depth. Also, use of a baffled air inlet decreased the turbulent intensities within the structure, thus lessening the degree of air mixing in the ventilated space. High velocity regions near slotted floor openings appear likely to introduce malodorous and possibly toxic gases into the animal environment. The effect of slotted floors on air-flow characteristics in a model swine confinement building suggests that conventional inlet-exist location and design criteria in full scale buildings may be inadequate and may require new design standards, however, full scale validation of the results presented here should be obtained. (Solid Waste Information Retrieval System)

## 1914-A4, A11, B1, E3, F5

### PAUNCH MANURE AS A FEED SUPPLEMENT IN CHANNEL CATFISH FARMING

Oklahoma Cooperative Fishery Unit
BSF&W
Oklahoma State University
Stillwater
R. C. Summerfelt and S. C. Yin
Environmental Protection Agency Report No. EPA-660/2-74-046, May, 1974, 114 p. 12 fig, 38 tab, 50 ref.

Descriptors: Aquaculture, Water pollution, Agriculture wastes, Abatement, Beef cattle, Water quality
Identifiers: Channel catfish farming, Fish farming, Fish nutrition, Paunch manure, Abbattoir wastes, Recycling animal wastes, Slaughterhouse wastes, Food processing wastes.

Part A of this report examines the feasibility of using dried paunch at 10, 20 and 30 percent levels in feed for pond-rearing yearling catfish. Part B describes the effects of fish culture, using standard feeds and paunch-containing feeds, on water quality of fish ponds. In all, one physical, one bacteriological, and fifteen chemical parameters were measured. Regardless of feed type, pond-reared fish grew faster than the cage-reared fish. There was no significant difference in final weights attained by fish given standard, and 10 and 20 percent paunch feeds but fish given 30 percent paunch were significantly smaller. Feed costs per kg of catfish produced using the standard commercial sinking feed and sinking feed containing 10 percent paunch were essentially equal, but feed costs for making sinking feed with 10 and 20 percent paunch were greater than the standard. The cost of making a floating feed containing 10 percent paunch for raceway or cage culture of channel catfish were uneconomical. Neither the pond culture nor the cage culture caused deterioration in water quality in any of the ponds to any appreciable degree in one growing season of 24 weeks, and there was no significant difference in water quality in general between the ponds in which commercial feeds were used and those in which paunch-containing feeds were used—this was true in both pond and cage cultures. (Summerfelt-Oklahoma State University)

## 1915-A2, A3, A4, A5, A9, B2, B3

### METHODS AND PRACTICES FOR CONTROLLING WATER POLLUTION FROM AGRICULTURAL NONPOINT SOURCES

Environmental Protection Agency Office of Water Program Operations Publications EPA-430/9-73-015, October 1973, 83 p. 18 fig. 34 ref.

Descriptors: *Water pollution control, *Farm wastes, *Sedimentation, *Nutrients, Erosion control, Pesticides, Fertilizers, Wind erosion, Soil conservation, Farm management

Potential nonpoint agricultural sources of surface and groundwater pollution include sediment, pesticides, fertilizer, and plant and animal wastes and residue from cropland, grazing acres, and farm woodlots. Sound management practices are the key to achieving acceptable water quality. Proper land use and agricultural management practices will keep soil, plant nutrients, and organic matter on land, rather than allow them to become part of the waterborne pollutant load. Erosion may be reduced by means of conservation tillage, terraces, diversions, stripcropping, contouring, grassed waterways, crop rotations, and by management. Reducing nutrient losses from agricultural operations can be accomplished by three general approaches: (1) determining the proper amount, time, and method of plant nutrient applications to ensure efficient use by plants, (2) adopting approved cultural practices, including tillage and crop rotations, and (3) reducing soil and water runoff. There are several approaches to reduce the quantity of pesticides entering surface water and groundwater. These include: controlling erosion and minimizing wind drift; reducing the quantity of pesticides used, and using biodegradable, rather than persistent pesticides. Appropriate animal and land management practices should be followed. These include: (1) spreading acceptable rates of manure uniformly on land; (2) applying feedlot runoff effluent on land as recommended for specific site conditions; (3) maintaining an adequate land-to-livestock ratio on pastures; and (4) locating feeders and waterers a reasonable distance from streams and watercourses. (Knapp-USGS)

## 1916-A11, B3, C2, E3

### COMPOSITIONAL CHANGES IN RECYCLED CHICKEN MANURE

Agricultural Research Service
United States Department of Agriculture
Northern Regional Research Laboratory
Peoria, Illinois
J. H. Sloneker, B. F. Kelson and C. J. Flegal
Presented at the 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 12 p. 7 fig. 2 tab, 18 ref.

Descriptors: *Recycling, *Poultry, Performance
Identifiers: *Refeeding, Egg production, Compositional changes

A study was undertaken to determine changes, if any, in the composition of DPW recycled at 12.5 and 25 percent levels in layer feed. Cellulose, total neutral carbohydrate, lignin, ash, nitrogen, and amino acid composition were followed for 23 feeding cycles. Some microbial activity occurred during storage (up to 7 months) before analysis. Although carbohydrate content of the DPW fluctuated randomly, average levels of the major aldoses remained fairly constant. The lignin content remained essentially constant throughout the 23 cycles. Ash content and amino acid content increased while total nitrogen decreased. The data collected in this study level without the accumulation of the indigestible plant tissues and without a significant reduction in feeding efficiency and egg production. (Cartmell-East Central)

## 1917-A11, B2, E1, F1

### DO FLUMES REALLY WORK?

Beef Managing Editor
B. Fleming
BEEF, Vol. 10, No. 11, p. 3-7, July, 1974. 9 fig.

Descriptors: *Flumes, *Performance, *Confinement pens, *Costs, Flood control, Design, Operation and maintenance.
Identifiers: *Flushing, *Western cornbelt, Traffic patterns.

A tour was taken into the Western Cornbelt to get some first-hand views of the new slot and flume confinement buildings. Not a single operator was found who was discouraged with the system. The operators plan additional buildings, using the flume system. Only minor changes are planned. Every operator contacted admitted to flooding the floor, until it was learned how to control the flushing process. To keep flumes from freezing, most operators did increase the frequency of flushing during extremely cold weather. Dirty cattle seem to be a problem the first weeks in a new barn. Owners agree the barns seem to start damp—then gradually improve. As to the number of cattle in a pen, the American Beef expert says, "The theory of 18 square feet per 1,000 pounds of body weight is about right." Traffic patterns in pens, building design, and number of flumes are discussed. It was concluded that flumes can cut about $50 per head off the cost of a confinement barn. (Cartmell-East Central)

## 1918-B2, B4, E1

### NEW PUMP, NEW SYSTEM FOR LIQUID MANURE

N. Reeder
Farm Journal, Vol. 95, No. 6, p. D-9, June, 1971, 3 fig.

Descriptors: *Liquid wastes, *Costs, *Design, Waste storage.
Identifiers: *Piston-type pump, Outdoor pit.

Clinton Nesseth from Nesseth Farms, Dafter, Michigan has invented a manure transfer and storage system that stores semi-solids for six months in an outdoor pit. A piston-type pump forces the manure from the barn into the pit even in the coldest weather. REAP will pay up to $2500 to help build the pit. In the winter of 1970, the pump pushed 1700 cu. yards of manure out to the pit through an underground pipeline that enters the pit at the bottom. Nesseth estimates the pump will cost $2000 installed. Inquiries may be made at Nesseth Farms, Drafter, Michigan 49724. (Cameron-East Central)

## 1919-B2, B3, E1, E2

### LAGOON SYSTEM CHEAPER FOR SMALL DAIRY HERDS

J. L. Stallings.
Progressive Farmer, Vol. 89, No. 4, p. 88, April, 1974.

Descriptors: *Costs, *Lagoons, Dairy industry.

In an Auburn Experiment Station project, a lagoon system for dairy waste disposal for small herds, was the cheapest system studied. The four systems tested were (1) a conventional system using a scraper-loader and manure spreader, (2) a flushing-irrigation system, (3) a semiliquid system using a holding tank and a tank spreader, and (4) a two-stage lagoon system. As herd size increased to slightly more than 240 cows the conventional system was the least expensive of the confinment systems. But the flush-irrigation system became increasingly cheaper per cow as herd size increased. The lagoon system was the cheaper of the partial-confinement systems up to its capacity of about 240 cows. The capacity could be increased by constructing a larger lagoon or several more lagoons. (Cameron-East Central)

## 1920-A2, B2, F6

### FARMLAND FARM STRESSES NO RUNOFF, LATEST TEST RESULTS

Feedstuffs, Vol. 46, No. 50, p. 13, December 9, 1974, 6 fig.

Descriptors: *Agricultural runoff, *Livestock, *Experimental farms, Research and development.
Identifiers: Oxidation ditch, Waste handling.

At Farmland Industries new research and demonstration farm, under the supervision of Dr. Buell W. Beadle, there is no runoff of livestock wastes into nearby ditches or creeks. Located at Piper City, Kansas, the farm is fully self-contained. Oxidation ditches and aerobic bacteria solve the manure handling problems in the swine, poultry and dairy units. The research farm includes a swine unit, consisting of farrowing house, nursery, finishing house and gestation barn. The poultry unit has a capacity of 4,400 layer hens in the two houses. It is environmentally controlled and the cages are over an oxidation ditch. The beef cattle unit has a 300-head capacity. The 20 pens of cattle also serve as test gronos of feed formulations or comparisons of CO-OP Feed versus competitive brands. Other facilities on the farm include a feed mill, a stable for 6 horses, a show arena, a necropsy unit with laboratory and post-mortem facilities, and a waste research facility for studying new and improved methods of animal waste disposal. The work at Farmland's is closely coordinated to make test results most meaningful to co-op members in their own farming and ranching. (Cameron-East Central)

## 1921-A8, B1, C2

### ABANDONED FEEDLOTS CAN POLLUTE MORE THAN ACTIVE ONES

Crops and Soils Magazine, Vol. 27, No. 3, p. 23, December, 1974.

Descriptors: *Feedlots, *Nitrogen.
Identifiers: Abandoned feedlots, Nitrate concentrations, Pollution.

Lloyd N. Mielke, U. S. Department of Agriculture and University of Nebraska soil scientist, has been conducting a studv of the nitrate concentrations beneath feedlots. Under abandoned feedlots, he found an average concentration of 3.2 tons of nitrates per acre in the top 30 feet of the soil. Under active feedlots, he found only 0.8 tons per acre. The makeup of the surface of the feedlot is the reason for this difference. Active feedlots have an impenetrable seal on their surface that prevents air and water from getting through. The nitrogen under this seal is kept in a relatively immobile organic form. (Cameron-East Central).

## 1922-A10, A11, B1, C1

### KAOLIN RESULTS IN DRIER DROPPINGS

Poultry Digest, Vol. 32, No. 378, p. 346, August, 1973.

Descriptors: *Poultry, *Additives.
Identifiers: *Excreta, *Kaolin, Fly-control.

Some egg producers in Central Georgia are using clay (Kaolin) in small amounts in poultry feed. This material added in small amounts can have several benefits. It keeps the intestines of the hens in better condition and acts as a soothing agent. It makes droppings drier than they would normally be. In caged layers, it helps control flies since wet manure is an ideal fly-breeding ground. One egg producer who keeps daily feed intake records on 150,000 hens claims kaolin reduced feed intake by as much as 4 percent to 6 percent. (Cameron-East Central)

## 1923-B1, D2, E3

### METHANE PRODUCTION NOT EASY OR PRACTICAL

Crops and Soils, Vol. 27, No. 3, p. 18, December, 1974.

Descriptors: Methane, Cattle, Recycling.
Identifiers: *Manure, Crop residues.

With the shortage of fuel, there is talk about producing methane from manure or crop residues. R. E. Graves, agricultural engineer at the University of Wisconsin, says this practice is not yet feasible for farmers. This gas is produced when the organic matter decays if certain conditions are just right. A special machine is needed to produce the correct conditions, which include mixing, a lack of oxygen, and a relatively constant temperature. Also, some means of collecting and storing the gas is needed. And, since the gas is explosive, certain safety precautions should be observed. The total amount of output that could be produced each day from the manure of a 100-head herd of 1,400-pound cows would only be 10 percent of what is required to operate a crop dryer for a day. (Cameron-East Central)

## 1924-A10, B1, B5, C1, C3, E4

### BIOLOGICAL DIGESTION OF MANURE BY DIPTERA

Colorado State University,
B. F. Miller
Feedstuffs, Vol. 41, No. 51, p. 31-32, December, 1969. 7 tab.

Descriptors: *Manure, *Diptera, Feeds.
Identifiers: Biological digestion.

This research involved a study of cultural methods for the housefly. The adult breeder flies were housed in 2 x 8 x 5 foot cages. The flies were fed a dry mixture of skim milk, yeast and sugar. It was felt that dried skim milk might be sufficient for the adult flies. Water was provided in inverted beakers with a paper towel to soak up the water. The flies sponged this water from the moist paper towel. Manure was used as a media for deposition of fly eggs. The eggs were added to the manure at the rate of 3 grams of eggs to 4,000 grams of fresh manure. About 60 percent of the moisture in the fresh manure was lost during digestion. Preliminary work indicated that fly pupae were a good protein source for chickens. Amino acid analysis indicated that it was comparable to fish meal as a protein supplement. (Cartmell-East Central).

## 1925-A4, B1, E1, F2

### SOIL CONSERVATION SERVICE TEXAS TECH UNIVERSITY WORKSHOP COMMITTEE ON FEEDLOT WASTE

United States Department of Agriculture, Soil Conservation Service.
Soil Conservation Service Texas Tech University Workshop Committee on Feedlot Waste, Texas Tech University, Lubbock, July 28-29, 1971, 44 p. 9 fig, 6 tab, 7 ref.

Descriptors: *Farm wastes, *Feedlots, Water quality, Water pollution, Waste disposal, Design criteria.
Identifiers: Pollution abatement systems.

The session consisted of presentations dealing with the state laws and procedures for protecting Texas Waters from feedlot wastes. Factors that affected the feedlot wastes and the quantity and quality of such wastes were discussed. Waste disposal methods and designs for feedlot pollution abatement systems were examined. (Kehl-East Central).

## 1926-B1,B5

### FACTORS AFFECTING QUALITY AND QUANTITY OF FEEDLOT WASTE COLLECTIONS

Water Resources Center
Texas Tech University
Lubbock
D. M. Wells
Soil Conservation Service Texas Tech University Workshop Committee on Feedlot Waste, Texas Tech University, Lubbock, July 28-29, 1971, 3 p.

Descriptors: *Liquid wastes, *Solid wastes, *Slurries, *Gases, *Feedlots, Slopes, Feeds.
Identifiers: Quality, Quantity, Feedlot surfacing.

Feedlot wastes occur in the liquid, solid, slurry and airborne forms. Factors that affect the pollution potential of these wastes are (1) size of cattle, (2) density of cattle, (3) slope of feedlot, (4) type of surfacing material, (5) type of ration fed, (6) climatic factors, (7) frequency of cleaning. The general way each of these affected feedlot wastes is given. (Kehl-East Central).

## 1927-A6, A10, B3, B5, C1, C2, C3, D3

### REDUCTION OF FEEDLOT WASTE BY STABILIZATION

Agricultural Engineering Department
Texas Tech University
Lubbock
W. Grub.

Descriptors: *Feedlots, *Cattle, Climatology, Population densities, Odor, Insects.
Identifiers: *Waste management, *Waste stabilization, *Composting, C/N ratio.

The organic stabilization of beef feedlot waste by composting can be done in specially designed digesters or in exposed open air piles. A biologically stable organic product can be obtained which is free from noxious odors and insect infestation. Initial physical, chemical and biological characteristics of the waste vary considerably. These characteristics vary because of differences in feed, population densities, climatic conditions and waste management during the accumulation period. The C/N ratio of the accumulated waste varies from 35 to 9 according to the above conditions. Aerobic composting requires at least 30 percent moisture content (based on wet weight). An optimum air supply rate of between 1.5 and 3 liters per minute per 100 pounds of organic material is required during the peak composting period. Stabilization time is dependent on feed type, initial waste condition and composting process management. (Kehl-East Central).

## 1928-A2, A8, B2, E2

### CROP RESPONSE TO WASTE MATERIALS FROM VARIOUS FEEDLOT COLLECTION SYSTEMS

Agronomy Department
Texas Tech University
Lubbock
E. A. Coleman.
Soil Conservation Service Texas Tech University Workshop Committee on Feedlot Waste, Texas Tech University, Lubbock, July 28-29, 1971, 6 p. 3 tab.

Descriptors: *Crop response, *Feedlots, *Agricultural runoff, Slopes, Surfaces, Cattle.
Identifiers: Solute concentration, Solute accumulation.

Feedlot runoff for crop production allows the reuse of liquid that otherwise would evaporate into the air. Although information is still being gathered on waste materials, the present data has indicated several effects. The great variability in solute concentration is due to rainfall evaporation, feedlot surface material, feedlot slope, feed ration, age of pit or catch basin and other factors that have not yet been determined. Runoff from concrete-surfaced lots has a greater solute concentration than comparable sloped dirt-surfaced lots. There is a positive correlation between solute concentration and the slope of dirt-surfaced lots. The most susceptible period for all crops tested was found to be germination and the period immediately following. Tolerance to feedlot runoff varies greatly with the species. Finally, it was determined that the solutes accumulate throughout the top 30 inches of the soil profile. (Kehl-East Central).

## 1929-A2, B2, B4, E2

### MANAGEMENT OF RUNOFF WATER IN RELATION TO FEEDLOT OPERATIONS

Soil Conservation Service
Temple, Texas
H. N. McGill
Soil Conservation Service Texas Tech University Workshop Committee on Feedlot Waste, Texas Tech University, Lubbock, July 28-29, 1971.

Descriptors: *Feedlots, *Agricultural runoff, *Irrigation, *Storage capacity.
Identifiers: Holding ponds.

A system of runoff retention and irrigation is generally considered to be the most practical and economical form of runoff control in Texas. Because of this, information was gathered to determine necessary size ratios of irrigated areas to feedlot areas for adequate runoff control. The study revealed that the required storage capacity varies with the ratio of irrigated area to feedlot area and the location in the state. The eastern part of the state would need a large amount of storage capacity. Considerable flexibility of operation is permitted in the western part of the state by holding ponds with the capacity to impound 25-year, 24 hour runoff from feedlots. Although feedlot runoff is not a dependable irrigation water supply, it can be used to supplement other sources. (Kehl-East Central),

## 1930-A5, A8, B2, B4

### SEEPAGE LOSS FROM HOLDING PONDS

W. B. Moody.
Soil Conservation Service Texas Tech University Workshop Committee on Feedlot Waste, Texas Tech University, Lubbock, July 28-29, 1971, 5 p. 3 fig.

Descriptors: Seepage control, *Permeability, Soil analysis.
Identifiers: *Holding ponds, Darcy's equation, Groundwater conditions.

Detailed calculations are given for a typical analysis of seepage losses from a proposed pond. Such losses may be estimated following an investigation of soil and bedrock characteristics and laboratory testing of the soils. Construction and protection of relatively impervious blankets are discussed. (Whetstone, Parker, Wells-Texas Tech University).

## 1931-A5, A8, A9, B1

### EFFECT OF CATTLE FEEDLOT WASTES UPON GROUND WATER — A COMMENTARY

Geoscience Department
Texas Tech University
Lubbock
W. D. Miller
Soil Conservation Service Texas Tech University Workshop Committee on Feedlot Waste, Texas Tech University, Lubbock, July 28-29, 1971, 5 p. 3 fig.

Descriptors: *Feedlots, *Groundwater pollution, *Seepage, *Pollutants, *Geology, Cattle.

Several categories of potential ground water pollutants are listed. These include inorganic dissolved solids; organic dissolved solids; trace metals;pesticides, insecticides and herbicides; and bacteria and bacterially derived products. Along with the effects of these potential pollutants, the feedlot geology must be considered in discussing the effects of feedlot waste on ground water. Significant factors to be examined are: surface topography, soil permeability, bedrock lithology, structure and permeability, and depth of ground water. Thus, some land areas are more susceptable to ground water pollution than others. In Texas, cases have been documented in the Edwards Plateau, the Gulf Cooast, and the High Plains. Further evaluation of the ground water pollution problem is needed. A study by Miller (1971) revealed that about 15-20 percent of the cattle feedlots in the Texas High Plains showed some evidence of seepage to the water table. Average nitrate, chlorides and dissolved solids concentrations are cited. (Kehl-East Central).

## 1932-A2, A4, B2, B4, E2

### SOIL CONSERVATION SERVICE STANDARD AND SPECIFICATIONS FOR POLLUTION ABATEMENT MEASURES FOR CONFINED LIVESTOCK OR POULTRY FEEDING OPERATIONS

Soil Conservation Service
Temple, Texas
E. L. Alexander
Soil Conservation Service Texas Tech University Workshop Committee on Feedlot Waste, Texas Tech University, Lubbock, July 28-29, 1971, 10 p. 1 tab.

Descriptors: Pollution abatement, *Confinement pens, *Livestock, *Poultry, *Regulation, *Agricultural runoff, Design criteria, Water pollution, Basins, Lagoons.
Identifiers: Site selection, Pollution control, Holding ponds, Land disposal.

Guidance and criteria applicable to practices and facilities for the diversion of uncontaminated off-site drainage and for the interception, settling, collecting and disposing of contaminated runoff from livestock or poultry feeding areas are explained. Criteria for the selection of a site and for the design of the feeding operation are given. (Kehl-East Central)

## 1933-A2, A5, B2, B3, B4, E1, F2

### GUIDELINES FOR HANDLING LIQUID WASTE FROM FEEDLOTS

Texas Water Quality Board
Austin.
D. L, Pittman
Soil Conservation Service Texas Tech University Workshop Committee on Feedlot Waste, Texas Tech University, Lubbock, July 28-29, 1971, 4 p.

Descriptors: *Feedlots, *Liquid wastes, *Agricultural runoff, *Waste water disposal.
Identifiers: *Solid waste disposal, *Waste Control Order for Cattle Feeding Operations, Holding ponds.

The procedure for obtaining a Waste Control Order for Cattle Feeding Operations from the Texas Water Quality Board is given. Application evaluation is primarily based on pollution control measures for the following: (1) collection and retention of feeding area runoff water, (2) disposal of accumulated waste water, (3) groundwater protection from holding pond waste water seepage, and (4) disposal of accumulated solid waste. The process of obtaining a waste control order generally takes 3 months or longer. (Kehl-East Central).

## 1934-A2, A4, A5, A8, B1

### KEEPING RUNOFF SAFE

Agricultural Research, Vol. 21, No. 10, p. 8, April, 1973. 3 fig.
**Agricultural runoff, *Rainfall, *Feedlots, Groundwater pollution, Infiltration, Solid wastes.

Continuing research is showing how and when Great Plains cattle feedlots may contribute to water pollution and is demonstrating that, with adequate control of runoff, feedlots can be acceptable neighbors. In cooperation with the Nebraska Agricultural Experiment Station, studies are being made of rainfall, snow, temperature, and evaporation as they affect pollution from sloping feedlots. These studies show that widespread contamination of ground water by infiltration from the feedlot surface is improbable. The research indicates that feedlots should be designed to restrict surface runoff, which may transport heavy loads of pollutants. The amount of solids transported in runoff may be less from a feedlot than from tilled bare soil. Snowmelt runoff may transport 10-12 times the amounts of solids removed in rainfall from the same feedlot, and the COD will thus be correspondingly higher. The potential pollution hazard from a particular feedlot can be determined only by study of the watershed of which it is a part—its hydrologic characteristics and its proximity to surface water sources. (Cameron-East Central).

## 1935-A11, B3, D2, E3

### BARN WASTES FOR FEED

Agricultural Research, Vol. 19, No. 7, p. 3-4, January, 1971. 3 fig.

Descriptors: Feeds, *Ruminants.
Identfiiers: Barn wastes, Refeeding, *Digestibility, Chemical treatment.

Agricultural Research Service animal scientists blended barn wastes into dehydrated and pelleted rations and tested chemical treatments that make barn wastes more digestible for ruminant animals. On a dry-matter basis, daily intake tended to be highest on untreated wastes. But digestibility of dry matter was greatest for the sodium chloride treatment, followed by sodium peroxide, sodium hydroxide, and untreated in that order. The investigators project that a lower level of barn wastes than the 85 percent tested might be effective as a forage substitute. (Battles-East Central).

## 1936-A4, A8, F6

### TRANSPORT RATE OF COD THROUGH A WET POROUS STRATUM — MEASUREMENT OF DIFFUSIVITY IN CATTLE MANURE SOLUTION

Chemical Engineering Department
Kansas State University
Manhattan
S. K. Choi, L. T. Fan, L. E. Erickson, and R. I. Lipper.
Transactions of the American Society of Agricultural Engineers, Vol. 14, No. 4, p. 720-726, July-August, 1971. 10 fig, 1 tab, 16 ref.

Descriptors: **Chemical oxygen demand, *Diffusivity, Water pollution, Percolation, Groundwater, Measurement, Mathematical models.
Identifiers: *Manure.

The transport rate of materials through various soil strata is important for determining pollution potential of waterways, by material introduced into the soil, at various distances from the water. In the present report, a mathematical model and the equations derived from it are related to the transport of organic matter (expressed as chemical oxygen demand) through soil. The model used was packed bed, saturated with water and topped by a well mixed pool of homogeneous solution; both finite and infinite packed bed thicknesses are considered. Analytical expressions for concentration of a solute in the packed bed and in the homogeneous solution are given as a function of time, and of distance from the interface in the former case. Experimental data were obtained for a sucrose solution of known diffusivity in an experimental setup established in accordance with the model, and for a sterilized manure solution. (Solid Waste Information Retrieval System),

## 1937-B5, D2, E3

### WASTES MAY PROVIDE FUEL FOR HEATING

Feedlot Management, Vol. 13, p. 31, June, 1971.

Descriptors: *Fuels, *Gases, Energy, Feedlots.
Identifiers: *Pyrolysis, Manure volume reduction.

Fifty to sixty percent of the gases produced by "anaerobic incineration" have fuel value. The heat content of manure is stated to be: poultry 7200 Btu/lb., beef cattle 6400, swine 5500, and dairy cattle 5000. Volume reduction and the production of dry innocuous residues are other advantages of pyrolysis. (Whetstone, Parker, Wells,—Texas Tech University).

### 1938-A6, A11, B1, B5
### SAGEBRUSH FOR ODOR CONTROL: IN THE FEED OR THE MANURE?
Feedlot Management, Vol. 14, p. 74, May, 1972.

Descriptors: *Sagebrush, *Feeds, *Performance, *Cattle, Feedlots, Taste.
Identifiers: **Odor control.

Studies at Colorado State University indicate that feeding chopped sagebrush in amounts of one or two lb./day has no effect on the cattle, but reduces manure odor. Salt in quantities of zero to four oz./day has no effect on gains. (Whetstone, Parker, Wells—Texas Tech University).

### 1939-D3, E3
### WASTE CONVERSION UNIT DEVELOPED
Feedlot Management, Vol. 14, p. 26, December, 1972.

Descriptors: *Feeds, *Methane, *Fermentation, *Anaerobic conditions, *Waste treatment, *Recycling.
Identifiers: *Refeeding.

"The Hamilton Standard Division of United Aircraft Corporation has developed a process that converts manure into a livestock feed product and at the same time produces sufficient methane gas to supply the heat and electricity to run the process." The process, still in the laboratory testing stage, operates in the absence of oxygen using bacteria present in the waste to accomplish fermentation. (Whetstone, Parker, Wells—Texas Tech University).

### 1940-B2, E3
### WARM WATER STUDY
Feedlot Management, Vol. 14, p. 61, December, 1972.

Descriptors: *Regulation, *Feeds, Algae, Feedlots, Irrigation.
Identifiers: *Generating plant, *Warm water, *Greenhouses.

Oregon State University is studying the possibility of routing warmed water from power plants through greenhouses raising cattle feed, breaking down animal wastes which could then feed algae, yeast or other single-celled proteins. These, in turn, would become cattle feed. (Whetstone, Parker, Wells—Texas Tech University).

### 1941-A2, B2, B3, B4, E1
### TOTAL WASTE MANAGEMENT SYSTEMS
J. Fetterolf.
Feedlot Management, Vol. 14, No. 5, p. 16-18, May, 1972. 3 fig.

Descriptors: *Feedlots, *Cattle, *Kansas, Agricultural runoff.
Identifiers: *Waste management, *Manure pack, Mounding.

A description is given of solid waste and runoff handling at three beef cattle feedlots in Kansas. Solid wastes are removed from all three lots by a commercial contractor. Manure can be stockpiled in the lots. When the lots are cleaned, about one inch of hardpack manure is left on the lot surface to reduce infiltration. The runoff systems involve collection and dispersion of liquids and have been designed to handle a one-time rainfall of over 6 inches. (McQuitty, Barber—University of Alberta).

### 1942-A2, B2, B3, B4, E2
### THAT INESCAPABLE BYPRODUCT
Feedlot Management, Vol. 14, No. 5, p. 20, May, 1972.

Descriptors: *Design, *Feedlots, *Colorado.
Identifiers: *Runoff control, *Land disposal, *Manure, Retention pond.

A description is given of the runoff control facilities and solid manure handling practices at a 6,000-head feedlot in Colorado. All solid wastes are applied to 600 acres of cropland. Runoff is collected in a retention pond. (McQuitty, Barber-University of Alberta).

### 1943-A2, A3, A10, B2, B3, B4, E2
### CLEANEST FEEDLOT IN KANSAS
J. F. Blair.
Feedlot Management, Vol. 14, No. 5, p. 52, 54, 66-67, May, 1972.

Descriptors: *Kansas, *Feedlots, Agricultural runoff, Lagoons, Costs, Performance.
Identifiers: *Chemical fly control, *Cleaning.

A description is given of manure handling and sanitation methods at a 14,000-head feedlot in Kansas. Manure is scraped from the lots twice each year and spread on cropland or mounded and sold to farmers. All the pens were carefully graded during construction so that all runoff flows to the back of the pens and is carried to a lagoon. Fly control is accomplished by chemical sprays at a cost of about $20.00/day for the chemical. The feedlot has not received any complaints from neighbors. (McQuitty, Barber-University of Alberta).

### 1944-A11, A12, E3, F2
### THE DOOR'S STILL OPEN TO REFEEDING CATTLE WASTE
Feedlot Management, Vol. 14, No. 5, p. 60, May, 1972.

Descriptors: *Cattle, *Regulation, *Proteins.
Identifiers: *Refeeding, *Manure.

The present stand of the U.S. Food & Drug Administration on the refeeding of animal wastes is discussed. Currently, this method of waste utilization is not approved because the waste may be adulterated with drugs and antibiotics or their metabolites and disease organisms may be transmitted to humans or other animals. Research objectives are outlined. (McQuitty, Barber-University of Alberta).

### 1945-B2, D1, D3, E3
### THIS PLANT WILL CONVERT WASTE INTO PROTEIN
Feedlot Management, Vol. 14, No. 5, p. 70-71, May, 1972, 2 fig.

Descriptors: Feeds, *Proteins, Thermophilic bacteria, Waste treatment, Fermentation, Equipment.
Identifiers: *Refeeding, *General Electric

A description is given of a new system for conversion of animal wastes into a high-protein supplement. Shredded manure is mixed with water to produce a slurry. Fibrous material is separated from the slurry and flows through a series of fermentation tanks in which thermophilic bacteria convert the cellulose, hemicellulose and lignin to usable protein. The soluble portion of the slurry is fermented for less time. All digested material is passed through a vacuum filter where water is removed and reused. The protein is further dried and is used as a feed supplement. (McQuitty, Barber-University of Alberta).

### 1946-A11, B1, D1, D3, E3, F1
### RECOVER, RECYCLE, REUSE
Agricultural Research, Vol. 21, No. 7, p. 8, January, 1973. 6 fig.

Descriptors: *Feeds, *Recycling, Livestock, Poultry, Feedlots, Cellulose, Proteins, Methane, Costs.
Identifiers: *Refeeding, *Fiber, *Board.

Studies are underway on wastes from feedlots and poultry cages, with research emphasis on such diversified products as protein-rich feed for livestock, cellulose for fiber and pulp products and enzymes to digest fiber. Manure from corn-fed cattle was fractionated by screening and filtering. Chemists believe that if the undigested fiber can be separated from the protein, refeeding the fractions may be a way to reduce this source of pollution. The residue fraction served as a nutrient for a fungus that produces a fiber-digesting enzyme. In another study, fiber digestion with enzymes and heat points the way to complete recycling of chicken manure. Results showed that cellulose and hemicellulose did not build up in waste that was dried and refed as 25 percent of the chicks feed ration through 23 cycles. Fiber has been considered indigestible by poultry. In a study of microorganisms in feedlot wastes, Dr. Rhodes obtained an isolate of Salmonella. Although only one pathogen was present among 1,500 isolates, Dr. Rhodes cautions, "indiscriminate refeeding of understerilized feedlot waste could be hazardous." (Cameron-East Central).

### 1947-A5, A8, B1, C2
### LITTLE POLLUTION FROM THIS FEEDLOT
Agricultural Research, Vol. 19, No. 6, p. 10-11, December, 1970. 2 fig.

Descriptors: *Feedlots, *Nebraska, Analysis, Nitrates, Gases, Nitrification, Climates.
Identifiers: *Groundwater pollution, Manure pack.

The results of an investigation concerning nitrate pollution of a shallow groundwater table, conducted on a flat cattle feedlot in Nebraska, are discussed. The 120-by-305 ft. lot was chosen for study because of such conditions as: stocking rate of 400 sq. ft. per animal; little manure removal; highly permeable soil; fluctuating high-water table; and little surface drainage. Observations and measurements indicated that the manure pack (nearly 1 ft. thick) and the soil and manure form a common interface that effectively bars water movement. Analysis of soil core samples showed that downward movement of nitrates and other forms of nitrogen in the soil is minor. Promotion by interface of aerobic conditions in the pack and anaerobic conditions below the interface leads to generation of nitrates by nitrification in the aerobic zone, while breakdown by denitrification occurs in the anaerobic zone. Biological activity in the two zones creates gaseous compounds such as ammonia, carbon dioxide, and amines, which are dispersed into the atmosphere. Seven wells were installed in and around the lot to obtain water samples and water table depth measurements. Water samples were taken periodically from wells next to the feedlot and analyzed. The estimates indicated that 20 to 40 percent of Nebraska cattle feeding operations are on flat, permeable soil. The measurements indicated that considerable amounts of solid wastes can be removed simply by decomposition on the lot. These field observations are supported by results of laboratory studies. (Solid Waste Information Retrieval System).

## 1948-A11, B1, C3, E3, F1

### THE EFFECTS OF FEEDING A HIGH CONCENTRATE RATION CONTAINING 25% GROUND BEEF MANURE TO FATTENING HEIFERS IN CONCRETE AND SOIL SURFACED LOTS

Department of Agricultural Engineering,
Kansas State University, Manhattan.
C. L. Drake, L. I. Smart, E. F. Smith, and R. I. Lipper.
55th Annual Cattlemen's Day, Kansas Agricultural Experiment Station, Kansas State University, Manhattan, May 1, 1968, Bulletin 518, p. 57-60, 2 tab.

Descriptors: *Feeds, *Performance, *Feedlots, *Costs, Analyses, Salmonella.
Identifiers: *Fattening heifers, *Concrete surface, *Soil surface, *Manure.

The purposes of this project were to compare a ration containing 25 percent ground beef manure with a conventional ration and to study the influence of concrete or soil surfacing on animal performance. Heifers on concrete-surfaced lots gained slightly more and were more efficient. Concrete-surfaced lots are faster and easier to clean than unsurfaced lots. Feed efficiency was the same for control heifers in both concrete-and soil-surfaced lots. Differences in feed costs per hundred weight were small in all cases, Samples of manure were analyzed in the veterinary diagnostic laboratory and found free of Salmonella organisms. (Cartmell-East Central).

## 1949-B1, C1, E2

### ERODIBILITY FACTOR OF BEEF CATTLE MANURE

Soil Conservation Service,
United States Department of Agriculture,
Effingham, Illinois.
J. L. Jeschke and D. L. Day.
Presented at the 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 10 p. 1 fig, 9 tab, 8 ref.

Descriptors: *Cattle, *Feedlots, *Solid wastes, *Waste disposal, Rainfall, Slopes.
Identifiers: *Erodibility factor, *Universal Soil Loss Equation.

The primary objective of this study was to develop a method of predicting manure solids loss from feedlots and areas where manure has been spread. Factors such as rainfall amount, intensity, slope, and erodibility of feedlot surface were included in the study. It was found that the Universal Soil Loss Equation dealt with many of the factors which are significant in manure solids movement. The erodibility factor obtained for manure solids loss was 0 [illegible]. This prediction method can be very useful for evaluating or comparing locations for new feedlots and areas where manure is to be landspread. It can also be used to evaluate the effects of slope, slope length, and various other factors on the solids loss expected from any given feedlot or field. (Cartmell-East Central),

## 1950-A11, B3, C2, D2, E3

### EFFECT OF PROCESSING METHOD OF BROILER LITTER ON NITROGEN UTILIZATION BY LAMBS

Department of Agricultural Chemistry,
Missouri University, Columbia.
B. W. Harmon, J. P. Fontenot,. and K. E. Webb, Jr.
Journal of Animal Science, Vol. 39, No. 5, p. 942-946, November, 1972. 2 tab, 17 ref.

Descriptors: *Performance, *Effects, *Feeds, Nitrogen, Digestibility.
Identifiers: *Sheep, *Broiler litter, *Processing, *Nitrogen utilization, pH, Dry heat treatment, Ruminal fluid.

Experiments were conducted to study the effect of acidifying broiler litter with sulfuric acid prior to processing on nitrogen loss during dry heat treatment. Two metabolism trials were conducted to study the effects of different methods of processing broiler litter on digestibility and nitrogen utilization by lambs. The rations containing litter were readily accepted by wethers and no feed was refused during the two trials. The apparent digestibility of dry matter, crude protein, ether extract and NFE did not differ significantly among rations containing litter. No significant differences were observed for blood urea or the ruminal fluid parameters. Values for ruminal fluid, pH, and volatile fatty acid concentration indicate that rumen fermentation was not greatly altered by feeding litter processed by different methods. (Cartmell-East Central).

## 1951-B1, C1

### EFFECT OF MOISTURE CONTENT ON THERMAL DIFFUSIVITY OF BEEF MANURE

Design Engineeer, Melroe Company,
Bismark, North Dakota.
R. L. Houkom, A. F. Butchbaker, G. H. Brusewitz.
Transactions of the American Society of Agricultural Engineers, Vol. 17, No. 5, p. 973-977, September-October, 1974. 4 fig, 2 tab, 12 ref.

Descriptors: *Moisture content, *Effects, *Thermal conductivity, *Specific heat, *Bulk density, Design, Drying.
Identifiers: *Thermal diffusivity.

The objective of this project was to determine the thermal conductivity, the specific heat, and the bulk density of fresh cattle manure as affected by moisture content in order to estimate the thermal diffusivity. The results indicated that conductivity and bulk density varied with moisture content with a considerable increase occurring from 45 to 65 percent moisture content; the material was extremely sticky in this range of moisture contents. Thermal diffusivity was essentially independent of moisture content. (Cartmell-East Central).

## 1952-B2, B5, C1, C2

### EFFECT OF SPRINKLING ON LIQUID ANIMAL WASTE PROPERTIES

Environmental Chemist,
Minnesota Mining and Manufacturing Company,
St. Paul.
S. K. Welsh and P. R. Goodrich.
Presented at the 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4034, 16 p. 4 fig, 3 tab, 9 ref.

Descriptors: *Sprinkling, *Liquid wastes, *Chemical properties, *Physical properties, Livestock, Moisture content, Chemical oxygen demand, Ammonia.
Identifiers: *pH.

The main objective of this research was to determine whether or not any physical or chemical changes occurred in liquid animal waste material as a result of pumping and sprinkling. Specific characteristics observed were moisture content, chemical oxygen demand, ammonia content and pH. The types of wastes observed were beef cattle, dairy cattle, and swine wastes. An average moisture loss of 0.10 percent occurred from the liquid animal waste material in the pumping and sprinkling trials. There was no significant change in ammonia content and chemical oxygen demand. The pH increased an average of three-tenths of one pH unit as a result of pumping and sprinkling. It was felt that this increase was caused by the mixing and pumping parts of the system rather than the sprinkling part. (Cartmell-East Central).

## 1953-B3. D1, D3

### A MECHANIZED COMPOST CHANNEL FOR ANIMAL WASTE

Agricultural Engineering Department,
Maryland University, College Park.
J. W. Hummel, W. F. Schwiesow, and G. B. Willson.
Presented at Annual Meeting, American Society of Agricultural Engineers, 1972, Paper No. 72-456, 15 p. 6 fig, 6 tab, 6 ref.

Descriptors: *Design data.
Identifiers: *Mechanized compost channel, *Dairy manure, *Power requirements.

An elevating mechanism with supporting carriage was designed based on preliminary data and observations. The mechanism passed through the channel to mix, agitate and move the composting mass an increment of the channel length. Thus, the elevating mechanism served a dual role as an agitator and as a material transport device. Details of the carriage design are given, Design modifications are necessary for more efficient operation of the system, but the mechanized channel has proved to be a promising device for composting agricultural wastes. (Cartmell-East Central).

## 1954-A11, B2, D3, F1

### EXPERIENCES WITH OXIDATION DITCHES IN A PULLET GROWING HOUSE

Research Engineer,
Huskee-Bilt Construction Company
Monmouth, Illinois.
J. S. Stevenson and L. J. Roth.
Presented at the 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-452, 8 p. 1 fig, 1 ref.

Descriptors: *Poultry, *Design, *Costs, *Performance.
Identifiers: *Oxidation ditch, *Pullet growing house, *Waste Management.

An account of some experiences with oxidation ditches in a commercial pullet rearing operation is presented. Two identical side-by-side oxidation ditches were operated continuously for eighteen months in a 32,000-bird pullet growing house. The design criteria of 0.3 cubic feet of liquid volume and 8,000 birds per standard eight-feet aerator proved adequate. One ditch caused no problems with foaming or odor. The other ditch, started at a shallower rotor immersion and subjected to various experiments regarding liquid velocity and rotor immersion, exhibited severe foaming for four months. The foaming ceased after withdrawal of most of the liquid followed by addition of liquid from the non-foaming ditch. Dilution water was regularly added to the ditches to make up for evaporation loss and to keep the solids content at a desired level. Because effluent from the ditch dries readily and without odor on a drying bed and because it can be handled easily with conventional manure handling equipment, this waste management system is worth considering. The cost of operation is high, but this cost is offset partially by substantial reductions in labor, and perhaps by improved bird health. (Cartmell-East Central).

## 1955-A11, D1, D2, E3, F1

### FEEDING PELLETED DRIED POULTRY LITTER TO HOLSTEIN STEERS

Animal Nutrition Consultant,
Modesto, California.
A. A. Jimenez.
Feedstuffs, Vol. 46, No. 47, p. 29-30, November 18, 1974. 7 tab, 9 ref.

Descriptors: *Feeds, *Performance, *Cattle, *Costs.
Identifiers: *Dried poultry litter, *Refeeding.

The purpose of the experiment was to obtain data on weight gains, feed efficiency ratios and the cost of gains in growing steers fed substantial amounts of KOPRO. Another objective was to ascertain the validity of the energy value of KOPRO obtained from in vitro studies using the volatile fatty acid production litter which has been naturally dried, then ground and pelleted at high temperatures to eliminate pathogens. The two experimental groups of steers receiving KOPRO gained well, but with the exception of the first period, they never quite matched these gains of the control pens. The cost per unit of gain consistently favored the KOPRO-fed groups. During the entire trial no health problems associated with the feeding of KOPRO were observed. Cattle consumed KOPRO readily and with good appetite. (Cartmell-East Central).

## 1956-A2, A8, B2, C2, E2

### DISPOSAL OF EFFLUENT FROM A BEEF CATTLE FEEDLOT RUNOFF CONTROL HOLDING POND

J. A. Nienaber, C. B. Gilbertson, T. M. McCalla, and F. M. Kestner.
Transactions of the ASAE, Vol. 17, No. 2, p. 375-378, March-April, 1974. 1 fig, 6 tab, 11 ref.

Descriptors: *Feedlots, *Cattle, *Application methods, *Sampling, *Nutrients.
Identifiers: *Runoff control, *Effluent disposal, *Holding pond.

Results are given for a field study initiated in 1970 to determine the minimum area required for feedlot runoff disposal as affected by applied nutrients and water and disposal area runoff control requirements, A minimum area of one-half acre disposal area per acre of feedlot did not impair crop production or cause a pollutant accumulation in the soil profile for the two year test period. Vegetation yields indicated no discrimination by the cattle grazing on effluent treated areas. A mixture of grasses resulted in the dominance of two species of grass — bromegrass and intermediate wheat grass. Intermittent effluent application by on and off cycling resulted in a higher total application without runoff based on application amounts attained in 1971 and 1972 under similar late fall climatic conditions. Final design for this experiment provides for return of surface runoff from the disposal area to a holding pond for recycling. (Cartmell-East Central).

## 1957-A4, A6, A11, A12, B1

### AMMONIA AND RELATED GASES EMANATING FROM A LARGE DAIRY AREA

R. E. Luebs, A. E. Laag and K. R. Davis.
California Agriculture, Vol. 27, No. 2, p. 11-12, February, 1973. 2 fig, 2 tab.

Descriptors: *Ammonia, *Water pollution, *Dairy industry, Odor, Sampling, California,
Identifiers: *Volatilization, *Amines, Chino-Corona area.

Volatilization of nitrogen from animal wastes in combined forms, principally ammonia, can constitute a real problem. Amines that form can cause odor. Ammonia that forms may be absorbed from the atmosphere by surface waters. Combined with ammonia enriched rain water, such absorption could create a health hazard to persons or animals drinking the water. Approximately 400 dairies serving the greater Los Angeles area are located in 60 square miles near Chino, California. Sampling sites were located a minimum of 200 feet from the nearest dairy corral to permit representative sampling. Ammoniacal plus possibly small amounts of amine nitrogen were 20 to 40 times higher in the dairy area than in an urban area 7 miles upwind from the dairy area. The area over which the atmosphere was enriched totalled 224 square miles, 3.7 times greater than the area where the dairies were concentrated. Such concentrations would be a real danger to surface waters in the area. Fortunately, there are no permanent open storage water reservoirs in the Chino-Corona dairy area. (Merryman-East Central).

## 1958-A5, A8, B2, C2, E2

### LYSIMETER STUDIES WITH LONG TERM APPLICATION OF SWINE LAGOON EFFLUENT

Department of Biological and Agricultural Engineering, North Carolina State University, Raleigh, North Carolina.
R. L. Parker, J. Wang, M. R. Overcash, and F. J. Humenik.
Presented at the 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4036, 13 p. 10 tab.

Descriptors: *Lagoons, *Effluents, *Application rates, *Lysimeters, *Nitrogen, *Phosphorus, Oxygen demand.
Identifiers: *Swine, *Groundwater pollution, *Removal, Organic carbon.

The application of swine waste lagoon effluent to lysimeters exposed to weather conditions up to a hydraulic rate of 1 inch per week and a process load of about 3000 lbs. nitrogen/acre/year continuously for over two years has resulted in essentially complete removal of phosphorus and excellent reduction of oxygen demand and organic carbon. Investigation of lysimeters with water table control showed that additional nitrogen reduction, specifically lower nitrate concentrations, can be achieved without supplemental carbon addition and with no decrease in the associated removal of organic carbon and oxygen demand. Removals of organics and nitrogen were reduced when the soil surface remained saturated either due to poor infiltration or control of the water table too near the soil surface. It was determined that controlled denitrification could provide for nitrogen reduction of soil water, and if the land disposal site were properly located and managed, a significant lowering of groundwater nitrate concentrations could be obtained before the flow left the owner's property. (Cartmell-East Central).

## 1959-B2, C2, D3, E3, E4, F5

### ANIMAL WASTE CONVERSION SYSTEMS BASED ON THERMAL DISCHARGES

Department of Soil Science,
Oregon State University, Corvallis.
L. Boersma, E. W. R. Barlow, J. R. Miner and H. K. Phinney.
Special Report 416, Agricultural Experiment Station, Oregon State University, Corvallis, September, 1974, 54 p. 12 fig, 11 tab, 96 ref.

Descriptors: *Recycling, *Animal wastes, *Feeds, *Methane, *Electric power industry, Proteins, Anaerobic digestion, Costs, Pollution abatement, Nutrients.
Identifiers: *Refeeding.

Society faces many problems related to its growth in numbers and standard of living. Of major concern is environmental degradation resulting from pollution and the consumptive use of non-renewable natural resources. An animal waste management scheme was developed on the premise that one solution to these problems is the development of integrated production systems with recycled sources. The waste product of one industry must become the raw material for another. The feasibility of using waste heat from steam electric plants to sustain a food-producing complex which recycles nutrients is analyzed. Specifically, it is proposed to use microorganisms to convert animal waste into a high protein animal feed and a methane-rich fuel gas. Waste heat from steam electric plants is used as a low cost source of energy for maintaining stable, elevated temperatures in anaerobic digestion and single cell protein production units. Benefits to society include: improved efficiency of energy use and food production, minimization of pollution problems associated with food production, recycling of raw materials, and conservation of non-renewable resources. (Boersma, Barlow, Miner and Phinney).

## 1960-A11, B1

### COMPARISON OF SELECTED ENVIRONMENTAL CONDITIONS AND BEEF CATTLE PERFORMANCE IN POLE TYPE AND CLOSED ENVIRONMENTS

Agricultural Engineering Department,
South Dakota State University, Brookings.
M. A. Hellickson, W. B. Witmer and R. Barringer.
Transactions of the ASAE, p. 536-538, 542, 1972. 6 fig, 14 ref.

Descriptors: *Performance, *Environmental control, *Cattle, Temperature, Ventilation, Humidity.
Identifiers: Slotted floor.

Producers of feeder cattle have begun to adopt controlled environment units for confined production of feeder cattle. Little is known, however, of the effects of such units on beef production. An evaluation and comparison of the performance of beef cattle reared in an open-front, pole-type building and in a closed environment building is presented. During the winter period, the environment had no significant effect on average daily gain or feed conversion of finished beef cattle. However, during the summer period, significantly higher average daily gains and feed conversions were found for the beef cattle finished in the pole barn. (Kehl-East Central).

## 1961-A8, E2, F6

### SIMULATION OF MISCIBLE DISPLACEMENT IN SOILS

Department of Agricultural Engineering,
Texas A&M University, College Station.
A. G. Smajstrla, D. L. Reddell and E. A. Hiler.
Presented at 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 31 p. 9 fig, 27 ref.

Descriptors: *Infiltration, *Mathematical models, Soils.
Identifiers: *Miscible displacement, *Simulation model, *Numerical dispersion.

In today's agriculture the characterization of ion movement through unsaturated porous media is extremely important. A simulation model was developed for the simulation of the miscible displacement of a conservative solute during one-dimensional vertical infiltration into a homogeneous, isotropic porous media. To solve the infiltration problem, an explicit finite difference technique was used. The method of characteristics to eliminate numerical dispersion was used to solve the transient convective diffusion equation. The accuracy of the simulation model results compared well with analytical solution, experimental data and other simulations. The study concluded that the shape of the solute distribution curve with depth is relatively insensitive to the magnitude of the dispersion coefficient for porous media to which the functional relationship used apply and for the range of pore water velocities commonly encountered during infiltration into sand and clay loam soils. The research also concluded that the dispersion coefficients are much larger and solute curves are very different for nonhomogeneous, anisotropic porous media than for homogeneous media. (Kehl-East Central).

## 1962-A4, A11, A12, B1, C2

### PROCEEDINGS OF CONFERENCES ON FARM ANIMAL WASTES, NITRATES AND PHOSPHATES IN RURAL WISCONSIN ECOSYSTEMS

Wisconsin University, Division of Economic and Environmental Development.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates, in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1971, 312 p.

Descriptors: *Farm wastes, *Nitrates, *Phosphates, *Wisconsin, Research and development.
Identifiers: *Waste management.

This conference considered several closely-related aspects of waste and nutrient management on rural Wisconsin farm land. The objectives of the conference were to provide background facts, new research findings, and suggestions for alternative management programs in rural areas. The conference dealt with three aspects of the agricultural sector's impact on environmental quality, namely farm wastes, nitrates, and phosphates as they affect water, food, and health. Techniques and designs for handling manure were considered. Action programs were discussed. (Cameron-East Central).

### 1963-A2, A3, A4, A5, A8, A11, A12, B1, C2, E2

### SOURCES AND FATE OF "AVAILABLE" NITROGEN IN RURAL ECOSYSTEMS

Associate Professor of Soil Science, Wisconsin University, Madison.
D. R. Keeney and L. M. Walsh.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1971, p. 22-40, 4 fig, 8 tab.

Descriptors: *Nitrogen, *Nitrates, *Runoff, *Groundwater pollution, Rural areas, Ecosystems, Crops, Soils.
Identifiers: Manure.

The most critical problem associated with nitrogen compounds in groundwater aquifers is the possible adverse health effects on humans and animals. All sources of nitrogen — precipitation, crop residues, soil organic matter, legumes, manure, and nitrogen fertilizer — are ultimately converted to the leachable $NO_3$-N form by soil bacteria. Nitrogen can be lost from the soils by crop removal, leaching, denitrification, and runoff. Losses of soil material and total nitrogen are directly related to amounts of runoff. Practices recommended for reduction of runoff losses include use of crop residues, application of animal manure in conjunction with crops, use of minimum tillage on slopes, and fertilization to stimulate early growth of crop. The total amount of $NO_3$-N in the soil profile can be related directly to the rate of nitrogen application and frequency of the fertilized crop in the rotation. Methods for controlling the rate of pollution of underground water are given. Also given are methods of reducing nitrogen input into water. (Cameron-East Central).

### 1964-A5, A8, B1, E1

### MOVEMENT OF GROUND WATER

District Chief, United States Geological Survey, Madison Office.
C. L. Holt and D. A. Stephenson,
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates, in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, February 1-5, 1971, p. 48-52, 1 fig, 7 ref.

Descriptors: *Groundwater pollution, *Movement, Waste disposal, Animal wastes, Flow system.
Identifiers: *Contamination.

Theoretical approaches to definition of ground-water flow systems and to ground-water/surface-water relationships have been formulated over the past 30 years. Scientists have demonstrated that flow system can be defined in the field with empirical geological and hydrological techniques. These techniques enable proper siting or waste disposal systems and enable a system operator to know in which direction and at what rate effluents will travel if they are in the ground, and where they will surface. Ground-water is derived from precipitation by infiltration through soil and includes all water within the saturated zone below the water table. The pattern of ground-water flow from a recharge to a discharge area constitutes a dynamic flow system. Problems involving ground-water contamination are difficult to solve because the investigator cannot trace the ground-water contaminant by a simple inspection at the land surface. The first indication that a ground-water problem even exists comes when a water supply well begins to produce water containing an offensive substance. The resolution of the problem of ground-water contamination is discussed. (Cameron-East Central).

### 1965-A1, B1, E1, F2

### THE ROLE OF THE WISCONSIN DEPARTMENT OF AGRICULTURE IN AGRICULTURAL POLLUTION PREVENTION AND CONTROL

Secretary, Wisconsin Department of Agriculture.
D. E. Wilkinson.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates, in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, February 1-5, 1971, p. 119-124.

Descriptors: *Wisconsin, *Environment, *Animal wastes, Regulation.
Identifiers: *Agricultural pollution, *Pollution control.

Donald Wilkinson, Secretary, Wisconsin Department of Agriculture, is optimistic about the prospects of developing a quality environment, one in which there is a high degree of compatibility between the ecological and economic community. There is an ever-increasing problem of cohabitation. The important part of this human-animal relationship is waste disposal and a clean environment. Since the total farm income in Wisconsin exceeds 1.6 billion dollars and since the livestock industry produces about 86 percent of this total, animal waste disposal is very important. The Department of Agriculture is concerned with many other types of wastes as well. Wilkinson stresses that it is foolish to think that environmental pollution can be managed by assigning agricultural waste and pollution to farmers, industrial pollution to industrialists and other types of wastes to the public in general. He feels that environmental problems will be solved only by integrated effort and coordinated management of resources at the rural-urban interface. (Cameron-East Central).

### 1966-A2, A4, A5, A9, B1, C2, E2

### SOIL POLLUTANTS AND THEIR EFFECTS ON CLEAN WATER

Department of Soil Science,
Minnesota University, St. Paul.
W. P. Martin.
Proceedings of Conference on Farm Animal Wastes, Nitrates and Phosphates, in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, February 1-5, 1971, p. 125-133.

Descriptors: *Pollutants, *Water pollution, Animal wastes, Soil erosion, Pesticides, Fertilizers, Nutrients.

Municipal, industrial and agricultural wastes are major causes of pollution and all three must eventually be moderated if the purity of our lakes and rivers is to be restored or maintained. Especially troublesome are agricultural sources: animal wastes, eroded soil, fertilizers, and pesticides. The disposal of organic wastes from farm animals and from other sources related to the farm enterprise has become a major management problem. If land disposal of wastes is to be used, soil type, topography, and land availability should be carefully considered when locating feedlots and processing operations. Terracing, minimum tillage, and land covers are means of combating soil erosion. Phosphatic fertilizers should be incorporated into the soil, if possible, in order to prevent it from being carried by runoff to surface waters. Measures should be taken to prevent nitrogen in fertilizers and organic wastes from entering surface and groundwater supplies. Pesticides must be realistically evaluated. It is likely that these potentially harmful compounds have benefits that far out-weigh their detrimental effects. (Cameron-East Central).

### 1967-A2,A4,A5,A8,B1,C2,E3

### PHOSPHORUS IN OUR ENVIRONMENT

Wisconsin Department of Natural Resources.
J. M. Cain and J. E. Kerrigan.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates, in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, February 1-5, 1971, p. 134-137, 5 ref.

Descriptors: *Phosphorus, *Fertilizers, Surface waters, Environment, Wisconsin, Nutrients, Water pollution.
Identifiers: *Manure.

Historical background, characteristics, and principal producers of phosphorus are discussed at the beginning of this report. A major concern is the increased concentration of phosphorus in surface waters. Manure and commercial fertilizers are the major sources of plant nutrients in Wisconsin. Estimates show that 48 percent of the total phosphorus supplied to Wisconsin crops was from manure. Much of the manure was applied on frozen ground so that it contributed significant quantities of soluble phosphorus to the spring runoff. Complications to the problem of phosphorus imbalance in the environment include such factors as the broad expanses of land and water involved, the low phosphorus concentrations at which problems occur in lake waters and the abundance and low cost of phosphorus which often preclude profitable recovery of phosphorus. The phosphorus problem must be considered as part of a group of interrelated problems of soil erosion, nitrogen fertilization, waste treatment, water use, and land use. (Cameron-East Central).

### 1968-A4,A5,A8,B1,C2,E2

### PHOSPHORUS IN THE RURAL ECOSYSTEM — RUNOFF FROM AGRICULTURAL LAND

Assistant Professor of Soils,
Wisconsin University.
R. Powell and J. Densmore.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates, in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, February 1-5, 1971, p. 136-166, 9 tab, 1 ref.

Descriptors: *Phosphorus, Agricultural runoff, Water pollution, Soil erosion, Fertilizers, Animal wastes, Ecosystems.
Identifiers: Agricultural land.

Public concern over pollution of the environment has increased considerably. Concern about water quality is foremost because the main result is visible degradation of the water, namely the growth of algae and weeds plus possible contamination of drinking water supplies. Estimates show that less than one-third of the phosphorus entering Wisconsin waters comes from agricultural land. Agricultural sources of phosphorus are mainly soil erosion, fertilizers and manures. Applications of these products on snow covered, sloping fields can be potential sources of phosphorus pollution. Incorporation of animal manures immediately after application conserves the nutrients and also reduces the soil erosion potential of a sloping field. Judicious placement of intensive feeding operations and careful handling of fertilizers and animal wastes will help to foster public relations between agriculture and her urban neighbors. (Cameron-East Central).

### 1969-A10, A11, A12, B1, F2

### WHAT OUR MILK MARKETS REQUIRE

Chief, Section of Grade A Milk Certification,
Division of Health, Wisconsin Department of Health and Social Services.
C. K. Luchterhand.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates, in Rural Wis-

consin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin. February 1-5, 1971. p. 205-207. 3 ref.

Descriptors: *Milk, *Waste disposal, *Regulation, Dairy industry.
Identifiers: *Cleanliness, Flies, Milk Ordinance and Code.

Public health regulations for the protection of milk supplies have always called for the cleanliness of the cow, the barnyard, the milker and for the elimination of areas where flies may breed. Improper manure disposal induces the breeding of flies, which are considered capable of transmitting infection, by physical contact or through excreta, to milk and milk utilities. Cows should not have access to piles of manure in order to avoid the soiling of udders and the spread of diseases among cattle. The Milk Ordinance and Code lists six requirements which must be met before the disposal of animal wastes is deemed to be adequate. The emphasis is on keeping the dirt out of the milk supply, maintaining the cleanliness of cows, keeping the surroundings clean so that the cows will not become soiled, and preventing fly breeding. Other considerations are given for working out methods of adequate manure disposal. (Cameron-East Central).

### 1970-A4, A5, A6, A10, B2, B3, B4, D3, E1, E2, F3

### FARM ANIMAL WASTE MANAGEMENT: WHAT OUR MILK MARKET REQUIRES

Administrator, Food Division, Wisconsin Department of Agriculture.
N. E. Kirschbaum.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1971, p. 208-210.

Descriptors: *Milk, *Animal wastes, *Waste disposal, *Dairy industry, Management, Wisconsin.

A rough estimate of the manure produced daily by dairy herds in Wisconsin is 200,000 tons. In the past, major efforts have been made to encourage daily removal and field spreading of animal wastes or manure. In General Order #124, certain provisions for the handling of dairy farm animal waste and human waste, as they would affect the production of milk, were established. Specific requirements found in the statutes are set forth in this report. These provisions are concerned primarily with the cleanliness of the cows, the breeding of flies, and the pollution of water used for drinking or for cleaning equipment. The daily removal and spreading of manure, which was previously recommended, is now being discouraged. Dairy farmers are now confronted with questions of lagoons, liquid manure handling operations, stacking of manure, and similar issues. All of these methods are unique in themselves and present problems with handling, odors, fly control, and possible water pollution. More research is needed to make certain that practical solutions are found for problems accompanying methods of animal waste storage and disposal. (Cameron-East Central).

### 1971-A2, B2

### CONTROLLING BARNYARD RUNOFF

Soil Conservation Service, U.S. Department of Agriculture, Madison, Wisconsin.
J. Densmore.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1871, p. 211-214.

Descriptors: *Waste disposal, Wisconsin, Feedlots.
Identifiers: *Runoff control, Barnyards, Soil Conservation Service.

A concerted effort has been made by the Soil Conservation Service, at the request of farmers, to provide technical assistance in planning and implementing needed measures to control feedlot and barnyard runoff. In providing a barnyard runoff control system, attention should be given to three basic steps: (1) making use of structures and practices that will intercept and divert all surface runoff not originating on the yard, (2) reshaping the lot to provide good surface drainage, and (3) collecting, conveying, storing and finally safely disposing of runoff from the livestock yard itself. To meet the problem in any feedlot or barnyard, one or perhaps all three of these steps may be needed. Temporary storage of barnyard runoff can be provided in a settling pond or basin and in a retention pond. Not only are good planning and construction essential for the success of farm animal waste disposal systems, but increasing attention will have to be given to maintenance and management. (Cameron-East Central).

### 1972-A2, A8, B1, C2, E2

### PLANNING LAND APPLICATION OF MANURE

Extension Agricultural Engineer, Wisconsin University, Madison.
L. R. Massie.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates, in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1971, p. 215-222. 6 tab, 2 ref.

Descriptors: *Planning, Agricultural runoff, Surface waters, Soils.
Identifiers: Land disposal, Manure.

The development of a system for land application of manure must consider land forms, surface runoff, and present or possible land use if organic pollution is to be kept to a minimum. Livestock producers now need to consider some additional dimensions when planning application of manure to their land. They must be concerned with movement of nutrients from their fields via the primary carrier, i.e., surface runoff water. Some soil conditions which may cause problems are internal drainage, slow water intake (infiltration) rates, rooting restrictions or shallow soils, erosion, and the location of the soil body on the landscape. A list of suggested practices for the application of manure to the land is given. Application of these practices will further the conservation effort for erosion control. Changes will be needed as additional information from research and experience become available. (Cameron-East Central).

### 1973-A10, B3, B4, E1, F3

### FLIES IN RELATION TO MANURE HANDLING

Extension entomologist, Wisconsin University, Madison.
W. L. Gojmerac.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1971, p. 223-226. 1 tab.

Descriptors: *Waste storage, *Dairy industry.
Identifiers: *Flies, *Manure handling, *Waste removal.

A study was done to evaluate the fly problem on farms where manure was stored and to compare them to other nearby farms regularly removing manure. Differences in average fly breeding scores between Grade A farms and manufacturing grade milk producers seem to indicate that a greater effort was made to keep fly populations low on Grade A farms. Nearly twice as many farms hauling manure regularly had significant fly breeding in gutters as compared to those stacking manure (36% to 19%). The average fly breeding potential on Grade A farms storing manure was lower than those regularly hauling (3.2 vs. 4.2). Regardless of the milk market classification, those farms storing manure appeared to have no more serious fly breeding problems in general than those farms regularly removing the manure. Further research is required to establish or define the conditions under which flies will breed in stored manure. (Cameron-East Central).

### 1974-A2, B2, B3, B4

### A PROCEDURE FOR DESIGN OF A MANURE STACKING FACILITY

Extension Agricultural Engineer, Wisconsin University, Madison.
E. G. Bruns.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1971, p. 227-232.

Descriptors: *Design, *Dairy industry, Agricultural runoff, Waste storage.
Identifiers: *Manure stacking.

Procedures for the design of a manure stacking facility are given for two different farms. There are five sections of design data for each farm. They are as follows: (1) livestock units, (2) daily manure production per animal unit per day, (3) solid storage requirements for 180 days of storage capacity, (4) runoff area, and (5) liquid storage capacity required for detention pond(s). (Cameron-East Central).

### 1975-B2, B4, D3

### LIQUID MANURE HANDLING

Extension Agricultural Engineer, Wisconsin University, Madison.
T. J. Brevik.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1971, p. 233-2[illegible]. 1 tab.

Descriptors: *Liquid wastes, *Waste storage, Lagoons.
Identifiers: *Waste handling, *Holding tanks.

Since manure is quite liquid naturally, there is considerable interest and research in handling it in liquid form. A good deal of the research underway today is directed toward some type of treatment while in storage — treatment which attempts to reduce the volume or to control odors. Terms, defined in this report, which relate to liquid manure storage and handling are holding pond, anaerobic lagoon, aerobic lagoon, oxidation ditch, detention pond, biochemical oxygen demand (COD), and settling terrace. Most on-the-farm liquid manure storages are, at the present time, underground holding tanks. Considerations and problems associated with holding tanks are discussed in the remainder of this report. Publications dealing with liquid manure handling are listed and are available through the County Agricultural Extension Office or through the Agricultural Engineering Department. (Cameron-East Central).

### 1976-A6, B2, D1, D2, D3

### RESEARCH PROGRESS IN MANURE HANDLING AND TREATMENT SYSTEMS FOR LIVESTOCK

Assistant Professor, Department of Agricultural Engineering, Wisconsin University, Madison.
J. C. Converse.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1971, p. 240-264. 8 fig, 3 tab, 16 ref.

Descriptors: Waste treatment, *Aerated lagoons, *Livestock, Research and development.
Identifiers: Odor control, Oxidation ditch, Flushing system.

Several treatment and handling systems for livestock wastes are discussed. Two such systems are the oxidation ditch and the aerated lagoon irrigation system. Aerobic degradation is explained in conjunction with these two different systems. Also described is Iowa State University's concept for flushing manure from a swine facility using renovated wastes. The description of these three handling systems is followed by a discussion of odor and chemical and mechanical methods of odor control. (Cameron-East Central).

## 1977-B1, B4, F2, F6

### UNIVERSITY OF WISCONSIN RESEARCH ON MANURE HANDLING

Agricultural Engineering Department,
Wisconsin University, Madison.
C. O. Cramer, R. F. Johannes, and G. H. Tempas.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1971, p. 265-269, 4 ref.

Descriptors: *Wisconsin, *Research and development, Design, Management, Waste storage.
Identifiers: Waste handling.

Research at the University of Wisconsin Experiment Station involves a study of manure handling systems utilizing waste storage facilities. Researchers wish to determine proper management design in order to minimize pollution and preserve the plant nutrient value of the manure. The systems must meet sanitary regulations for the production of milk or demonstrate the feasibility of the systems which would justify changes in these regulations. This research is being carried on at three of the University Experiment Farms, The Electric Research Farm, River Falls State University Farm, and several private farm cooperators. The design and operations of each facility are discussed in this report. (Cameron-East Central).

## 1978-A2, A5, A6, A7, A10, A11, B2, B4

### LARGE COMMERCIAL FEEDLOTS — HOW WASTES ARE HANDLED IN THE WEST

ARS-USDA, AERD, Nebraska University,
Lincoln.
C. B. Gilbertson.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates in Rural Ecosystems, Madison, Green Bay, and Eau Claire Wisconsin, Feb. 1-5, 1971, p. 270-279. 2 fig.

Descriptors: *Feedlots, *Nebraska, *Design, Performance.
Identifiers: *Waste handling, *Runoff control.

Research is underway for determining design factors for construction, installation and management of runoff control facilities on outdoor feedlots. There are three requirements for a functional runoff control facility: (1) a debris basin, (2) a holding pond, and (3) disposal area. Two separate management designs are available for installation. They are the "batch" system and the "continuous flow" system. Both systems must be designed for removal of settleable solids from the runoff. Many factors must be blended in the design of a feasible feedlot operation which will yield good animal performance and, at the same time, control all wastes, including surface runoff, groundwater contamination and nuisances such as odors, dust, and flies. Several steps are listed for designing and constructing a runoff control facility for a beef feedlot. Assistance for design, layout and construction may be obtained from local health authorities, Soil Conservation Service, Extension Agricultural Engineers, and practicing consulting engineers. (Cameron-East Central).

## 1979-A6,A10,B3,D1,D2,F1

### ACTION PROGRAMS FOR MANURE HANDLING

Department of Poultry Science, Wisconsin,
University, Madison.
J. L. Skinner, and J. W. Crowley.
Proceedings of Conferences on Farm Animal Wastes, Nitrates and Phosphates, in Rural Wisconsin Ecosystems, Madison, Green Bay, and Eau Claire, Wisconsin, Feb. 1-5, 1971, p. 295-300.

Descriptors: *Regulation, Dairy industry, Economics.
Identifiers: *Action programs, *Waste handling.

Requirements which need to be considered for the proper handling of manure are (1) regulations, enforcement agencies, and laws, (2) quantities of manure to be handled, (3) alternative approaches that are possible for the area and the species, (4) overall costs of different methods and approaches, and (5) economic limits within which the farmer can survive. Manure regulations for dairy farmers are particularly enforced and are specifically directed toward the assurance of milk quality. Clean cows and clean milking make daily cleaning essential. In addition, fly breeding and odors also must be controlled. A brief outline is given on groups which are concerned about waste disposal on the farm. Steps are suggested for an action program composed of all groups concerned. The goal of each program is to recycle the nutrients in manure. This must be done in the most economical manner that will produce a minimum of environmental pollution and that will not excessively offend any segment of the community. (Cameron-East Central).

## 1980-A11, D3, E3

### THE REUSE OF OLD LITTER

Wilson & Co., Inc., Poultry Division,
Federalsburg, Maryland.
D. E. Davis.
Proceedings of the 1969 National Poultry Litter and Waste Management Seminar, Salisbury, Maryland, September 29-30, 1969, p. 1-7.

Descriptors: *Litter, *Poultry.
Identifiers: *Reuse, *Built-up litter, *Marek's Disease, Composting.

About two years ago at the New Hampshire Poultry Disease Conference, Donald E. Davis reported that reusing litter in broiler houses aided in the reduction of Marek's Disease (MD). In an examination of clean-out vs. not cleaned out, the difference in condemnation based on USDA figures was .75 percent less on the flocks which were not cleaned out. The effect of the number of times broilers were placed on built-up litter was studied. There was a slight increase on the first and second time built-up. Of the different types of litter studied, softwood material gave better results and was more readily available and suitable to poultry production needs. Floors play an important role in MD control. Dirt floors gave better MD control than did other types. Although built-up litter will not bring MD to a .0 percent incidence, it would seem that we are forced to stay with the built-up litter program. (Cameron-East Central).

## 1981-A6,A10,B3,D1,D2,F1

### DEHYDRATION AN ECONOMICAL SOLUTION TO POULTRY MANURE PROBLEMS

Poultry Science Department, Pennsylvania State
University, University Park.
G. O. Bressler.
Proceedings of the 1969 National Poultry Litter and Waste Management Seminar, Salisbury, Maryland, September 29-30, 1969, p. 24-40. 5 tab.

Descriptors: *Dehydration, *Economics, *Poultry, *Farm wastes, *Waste treatment, Waste disposal, Odor.
Identifiers: Fly control.

Because of the huge problems of waste disposal in the poultry industry, many methods are currently under investigation to deal with these wastes. Perhaps the most promising means of disposal begins with dehydration. Penn State has been investigating dehydration with the objectives of removing as much water as possible, eliminating odors and flies, and developing an automatic system of manure handling. Experiments were conducted from 1967-1969 with very promising results. The weight of the manure was reduced to about one-fourth to one-third the original weight when the water was removed. Odors inside the house were practically eliminated. High velocity air speeded drying and prevented excessive bacterial growth. Labor was reduced, and since manure was being dried and removed while the birds were in the house there wasn't a large accumulation of manure. This in turn reduced "downtime" between flocks. Fly breeding areas were constantly destroyed so there were few fly problems. Finally, the overall capital investment requirements were low when compared to other methods. (Russell-East Central).

## 1982-A1, A6, A8, D1, E2

### WHAT HAPPENS IN THE SOIL WHEN MANURE IS USED?

G. H. Enfield.
Proceedings of the 1969 National Poultry Litter and Waste Management Seminar, Salisbury, Maryland, September 29-30, 1969, p. 50-56.

Descriptors: *Soils, *Bacteria, *Chemical reactions, *Decomposition, *Nitrogen, Odor.
Identifiers: *Land disposal.

When manure is applied to the soil, bacterial activities and biological and chemical reactions take place. These reactions are dependent on the following factors: (1) rate of application, (2) nature of the soil to which it is applied, (3) moisture content, (4) temperature, (5) availability of oxygen, (6) nature of the litter, (7) relation of nitrogen to carbon, (8) degree of acidity and (9) whether the manure left on the surface is incorporated or plowed under. In order to make these biological and chemical reactions work for us, certain steps need to take place. (1) Manure should be applied to soils deficient in nitrogen, phosphorus and potassium. (2) The crop grown should be responsive to these elements. (3) Manure should be spread thinly and disced under to prevent odor. (4) A well-limed sandy surface layer will help prevent the escape of ammonia to the atmosphere. (5) An impervious layer of clay under the sand will prevent excess nitrogen from leaching through the soil. (6) The area could be seeded with a fast development grass crop to convert $NO_3$ to less objectionable organic matter. After several years this topsoil could be sold as a potting mixture, as rich topsoil for golf courses, etc. (7) Another boon from this type of land disposal is an increase in the earthworm population. (Cameron-East Central).

## 1983-A8, B1, C1, C2, E2, F1

### USE OF POULTRY MANURE AND LITTER IN CROP PRODUCTION

Plant Science Department,
Delaware University.
L. J. Cotnoir.
Proceedings of the 1969 National Poultry Litter and Waste Management Seminar, Salisbury, Maryland, September 29-30, 1969, p. 131-138.

Descriptors: *Crop production, *Fertilizers, Litter, Moisture content, Nutrients, Costs.
Identifiers: Excreta, Application rates.

The use of poultry manure as a fertilizer for crops has decreased drastically in recent years for a number of reasons. Five factors influence the use of poultry manure on crops: (1) moisture content, (2) variability of the product, (3) nutrient balance of manure, (4) residual effect due to manures, and (5) costs of handling. The value of one ton of dry poultry manure is $11.86. If it contains 50 percent moisture, the value is only half of $5.93. Guidelines can be established for the most effective and efficient use of poultry manure in the following areas: (1) manure distribution, (2) land area, (3) quantity of manure, (4) crop benefits, and (5) when to apply. Recommendations on when to apply to the soil for specific crops is discussed. (Cameron-East Central).

## 1984-B3, F1, F4

### REVIEW OF AVAILABLE LITTER MATERIALS AND THEIR ADVANTAGES AND DISADVANTAGES

Department of Poultry Science,
Texas A&M University, College Station.
J. R. Howes.
Proceedings of the 1969 National Poultry Litter and Waste Management Seminar, Salisbury, Maryland, September 29-30, 1969, p. 140-149. 3 tab.

Descriptors: *Poultry, *Litter, *Material, Economics.

Requirements for good litter material are that they be: inexpensive, available, absorbent, dust free, easy to transport, buoyant, not consumed by birds, disease free and reusable if possible. Problems connected with litter are economical disposal and management. The greatest use of litter in North America today is for broilers, turkeys, layer replacements, and game birds. Litter materials that are available in North America are listed. Advantages and disadvantages of each litter material are given. (Cameron-East Central).

## 1985-A4, B2, C2, E2, E3
### IRRIGATION RESIDUES
J. P. Law and J. L. Witherow.
Journal of Soil and Water Conservation, Vol. 26, No. 2, p. 54-56, March-April, 1971. 13 ref.

Descriptors: *Irrigation effects, *Pollutants, Water quality control, Waste water (pollution), Pollution abatement, *Farm wastes, Return flow, I.
Identifiers: Salinity control.

The water quality problems associated with irrigation return flow are difficult to control. The major problems are the increased dissolved salt and nutrient content of waters draining from irrigated land. The difficulty in control is due to the diffuse nature of irrigation return flows coming from large irrigated areas and from both surface and subsurface drainage. Insufficient research has been devoted directly to the solution of return flow quality problems. Studies are needed to answer specific questions regarding both quantity and quality of irrigation residues. Possible control measures are discussed, but specific data concerning their effectiveness in abating water quality degradation are lacking. These must be evaluated and suitable management practices implemented to control water quality problems rising from irrigation. (EPA Abstract).

## 1986-B2, B3, D3, E3
### DISPOSAL AND RECYCLING OF AGRICULTURAL AND MUNICIPAL WASTES
Agricultural Engineering Department,
Colorado State University, Fort Collins.
T. Trout, J. L. Smith, and W. Downs.
Proceedings of the 87th Annual Research Conference, Colorado State University, Fort Collins, Colorado, Number 217, p. 86, 1974.

Descriptors: *Waste disposal, *Recycling, *Municipal wastes, *Colorado, Solid wastes, Slurries, Lagoons, Groundwater, Feedlots.
Identifiers: *Agricultural wastes, Waste collection.

The Agricultural Engineering Department of Colorado State University is currently involved in three research projects dealing with the disposal and recycling of solid and slurrified wastes. A subsurface sludge injection machine is used by the city of Boulder to dispose of part of their digested and slurrified sludge. The material is pumped from holding tanks through underground main lines to risers in the field and then to the operating machine via 660 feet of 6 inch diameter flexible rubber hose. A similar project at Fort Collins involves subsurface disposal of slurrified feedlot wastes. The project will be conducted in the same manner as the Boulder operation. The third project is concerned with the "harvesting" of cattle manure as an integral part of a waste recycling research program being investigated. To facilitate speedy handling of the material, a machine capable of rapidly collecting (large quantities of) manure from concrete floors is being developed. (Cameron-East Central).

## 1987-A5, A7, A8, B1
### BEEF CATTLE FEEDLOTS: IMPACT ON UNDERLYING SOIL
Agricultural Research Service, U. S. Department of Agriculture, Ft. Collins, Colorado.
F. A. Norstadt and H. R. Duke.
Proceedings of the 87th Annual Research Conference, Colorado State University, Fort Collins, Colorado, Number 218, p. 86, 1974.

Descriptors: *Soil profiles, *Groundwater, *Feedlots, Air pollution, Water pollution.
Identifiers: Manure pack.

Studies on commercial and experimental installations were made to determine changes in soil profiles and ground water beneath earth-surfaced beef cattle feedlots. The kinds and amounts of soil gases as well as the chemical constituents of the soil solutions are influenced by the depth and water content of a manure pack and seasonal soil temperatures. An experimental feedlot has been built to evaluate schemes to minimize both air and water pollution. A feedlot, with intact manure pack and under continuous use at a sufficient stocking rate, does not appear to be a pollution hazard to soil and underground water. (Cameron-East Central).

## 1988-D2, E3
### MODIFICATION AND ENZYMATIC HYDROLYSIS OF CATTLE FEEDLOT MANURE
Microbiology Department, Colorado State University, Ft. Collins.
G. K. Elmund, D. W. Grant and S. M. Morrison.
Proceedings of the 87th Annual Research Conference, Colorado State University, Fort Collins, Colorado, Number 221, p. 87, 1974.

Descriptors: *Feedlots, *Cattle, Cellulose, Cotton.
Identifiers: *Manure, *Fenton's reagent, Ferrous sulfate, Hydrogen peroxide, Enzymatic hydrolysis.

Evaluations were made of the use of Fenton's reagent (ferrous sulfate and hydrogen peroxide) for modifying the cellulosic fraction of cattle feedlot wastes. Manure samples were reacted in solution with 0.22 mM ferrous sulfate and initial hydrogen peroxide concentrations ranging from 0.1 to 5 percent. Manure and cotton substrates were also reacted with Fenton's reagent for two days and residual hydrogen peroxide removed with catalase. Results indicate that treatment of manure and cotton with Fenton's reagent modifies the cellulosic materials in such a manner thaet subsequent enzymatic hydrolysis is facilitated. The reaction products of such treatments are more readily biodegradable and may serve as substrates with biologically enhanced nutritional value in proposed refeeding processes. (Cameron-East Central).

## 1989-A11, E3, F1
### RECYCLING ANIMAL WASTE AND BY-PRODUCTS
Department of Animal Sciences,
Colorado State University, Fort Collins.
J. K. Matsushima.
Proceedings of the 87th Annual Research Conference, Colorado State University, Fort Collins, Colorado, Number 220, p. 87, 1974.

Descriptors: *Recycling, *Cattle, *Feeds, *Economics, *Performance.
Identifiers: *Animal wastes, *Paunch content, *Bloodmeal, *Protein content, *Refeeding.

Paunch content (10 percent protein content on dry basis) is a useless waste product of beef packing plants. Bloodmeal (about 80 percent protein) is also a byproduct of packing plants, but it can be merchandised. When the two ingredients are dried and blended in equal proportions the protein content is similar to cottonseed meal (45 percent protein) or other similar supplements commonly used in feedlo rations. A feeding trial was conducted to evaluate three different protein supplements. The three treatments were: (1) control supplement; basically cottonseed meal; (2) mixture of dried paunch-bloodmeal sunpplement; and (3) combination of cottonseed meal with paunch-bloodmeal. In spite of a temporary refusal of feed during rainy periods, the cattle fed the paunch-bloodmeal supplement consumed 65 pounds more corn per head over the 146 day period as compared to the controls. With the greater feed consumption the cattle weighed 22 pounds heavier per head when marketed. This increase was 6 percent greater with a feed saving of 3 percent per pound of beef produced. (Cameron-East Central).

## 1990-B1, C1, C2, E3
### THE DEVELOPMENT OF MANURE HARVESTING PRACTICES FOR BEEF FEEDLOTS
Agricultural Engineering Department,
Colorado State University, Fort Collins
R. Hansen and S. Marne
Proceedings of the 87th Annual Research Conference, Colorado State University, Fort Collins, Colorado, Number 227, p. 89, 1974.

Descriptors: *Feedlots, *Harvesting, *Management, Cattle, Recycling
Identifiers: *Manure

The recycling of beef feces is being done for various purposes. Preliminary investigations have indicated the physical and nutritional characteristics of the manure are extensively affected by the environment and management practice to which the manure is subjected before harvesting. A study is being initiated to determine the effects of controlled environment and constant management factors on the feed value and physical characteristics of manure. The field study will be conducted to determine the effects of measured operating conditions as related to changes which occur in manure with time and environment. Laboratory investigations will consist of a simulation study with controlled environment to determine the effect of various factors on manure. When the effects of this study are known, management programs can be developed to maximize the utilizable components of the manure and minimize the handling and processing requirements. (Cameron-East Central).

## 1991-A8, E2
### EFFECT OF THE APPLICATION OF BEEF-CATTLE-FEEDLOT MANURE ON CORN PRODUCTION
Agronomy Department,
Colorado State University, Fort Collins
T. A. Ruehr and R. R. Sabey
Proceedings of the 87th Annual Research Conference, Colorado State University, Fort Collins, Colorado, Number 223, p. 88, 1974

Descriptors: Cattle, *Feedlots, *Silage
Identifiers: *Manure, *Corn production, Application rates

Beef-cattle-feedlot manure was repeatedly applied to a Nunn clay loam on the Agronomy Farm at Fort Collins for three years starting in 1971. Another study was initiated in 1972 on adjacent plots to evaluate the residual effects of a single application of manure with rates up to 400 tons per acre. Corn silage was grown on the plots each year and corn grain yields were determined in 1972. The results of each year are given. These results suggest that manure applications of up to 400 tons per acre can produce high silage yields but the quality of the forage should be considered. (Cameron-East Central).

## 1992-A11, B2, B3, B5, F1
### EFFECT OF CLIMATE ON THE SELECTION OF A BEEF HOUSING SYSTEM
Department of Agricultural Engineering,
Oklahoma State University, Stillwater
A. F. Butchbaker, G. W. Mahoney, M. C. Paine and J. E. Garton
Presented at the 65th Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-444, 37 p. 10 fig, 3 tab, 20 ref.

Descriptors: *Climatology, *Feedlots, *Cattle, Air temperature, Evaporation, Precipitation (atmospheric), Costs, Performance, Great Plains
Identifiers: *Housing, Waste management, Site selection

This study, a portion of a major investigation devoted to evaluation of beef waste management alternatives, examined the relationship between climate, the beef feeding industry and its related waste management system. The objectives of the major investigation were: (1) to develop beef feedlot design criteria that minimize pollution by runoff waste and facilitate handling of solid and liquid animal waste, and (2) to examine alternative feedlot waste disposal systems to determine minimum cost systems for effective waste disposal. Factors that should be considered in feedlot site selection are marketing and transportation, feeder cattle supply, feed grain supply, land prices, agricultural practices and local topography, soil condition and climate. Environmental factors affecting animal performance are physical, social and thermal. The feedlots surveyed were of two types: open feedlots and those with confinement buildings. The three variables used to develop the climatic zones for livestock production were air temperature, evaporation and precipitation. The climatic zones were then subdivided into optimum and secondary areas. A discussion and comparison of open feedlot and confinement building operations' design and costs were given. The Southern Great Plains region of the United States was considered as an optimum climatic area for beef production year-around in open feedlots. (Kehl-East Central).

### 1993-B2, B3, C1, C2, D1

### STATIONARY SLOPING SCREEN TO SEPARATE SOLIDS FROM DAIRY CATTLE MANURE SLURRIES

Department of Agricultural Engineering,
Wisconsin University, Madison
R. E. Graves and J. T. Clayton
Presented at the 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-915, 16 p. 4 fig, 6 tab, 8 ref.

Descriptors: *Dairy industry, *Slurries, *Separation techniques, *Screens, Sludge, Flow ratio, Organic matter, Nitrogen
Identifiers: Total solids, Volatile solids, Settleable solids

When a water manure slurry is allowed to stand, a heavy mat and sludge usually form. Removal of these formations is often difficult. Slurries such as that of dairy cattle manure create special problems because of the quantities of fibrous material they contain. This study evaluated the usefulness of stationary sloping screens (.010, .020, .030, and .060 inch bar spacing) for the removal of solid particles from dairy cattle manure slurries. A commercially available stationary sloping screen was found effective. Tests compared the solids removal for slurries of dairy cattle manure ranging from 20:1 to 2:1 (water to wet manure by weight). The comparison tests indicated the following: (1) For slurries ranging from 20:1 to 5:1, the screens worked well. But slurries of 3.5:1 and 2:1 caused blinding of the screen and produced an effluent with fluffy floc that did not settle well. (2) With bar spacing from 0.060 to 0.010 inch, the amount of settleable solids remaining in the screen effluent decreased. (3) A decrease in flow rate must accompany a decrease in bar spacings. (4) As bar spacings decreased, the moisture content of screened solids increased. (5) In general, although solids removed by the screen were wet, they could be handled and piled much like wet manure. (6) When allowed to stand, the excess water that was removed with the solids drained out. (7) Solids that were removed by the screen were high in crude fiber and had a low ratio of organic matter to nitrogen. Agricultural applications were given. (Kehl-East Central).

### 1994-A6, B2, B4, F1, F2

### THIS PARLOR MAKES USE OF NEW IDEAS

D. W. Bates
Hoard's Dairyman, Vol. 119, No. 19, p. 1151, 1195, October 10, 1974, 4 fig.

Descriptors: *Dairy industry, *Design, *Montana, Ventilation, Odor
Identifiers: Holding pen, Waste pit, Flushing, Milking pit, Slotted floor

Ralph Parker and his sons at Sun River, Montana, were faced with the problem of replacing an old, 4-stall, u-shaped parlor with side-opening stalls. The old setup caused the milking time and the cleanup time to be too long. The rancher chose the herringbone design. A 60-cow holding area and a 10-cow double-5 herringbone parlor were constructed. In creating a ventilation system, the following factors were considered: comfort of the milkers, prevention of freezing when unoccupied, removal of heat produced by the animals in warm weather, and odor control. These objectives were met by continuous ventilation from the manure storage pit beneath the slatted holding area and the addition of heat intermittently. For cleaning purposes, the floor of the milking pit and the floor of the milk house were constructed on the same level. Wash water and flushing from both areas were to drain by gravity into the manure pit beneath the holding area. To accomplish this, the holding area floor was sloped upward 28 inches. This provided a 20-foot-long ramp for entering and leaving the stalls. Slate for the floor could not be obtained in Montana, so Parker made his own. Costs are listed. It was advised that if a system of the type described is planned, approval should be obtained from the health authorities having control of the sale of the milk before construction is begun. (Kehl-East Central).

### 1995-A1, B2, E3

### A TWO-CROP FISH PRODUCTION SYSTEM

Department of Entomology and Fisheries,
Coastal Plain Experiment Station,
Tifton, Georgia
T. K. Hill, J. L. Chesness, and E. E. Brown
Presented at the 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-536, 13 p. 8 fig.

Descriptors: *Fish farming, *Fish management, *Fish harvest
Identifiers: *Recirculation raceway system, *Two-crop fish production, Water reservoir, Intake screens

The study was an evaluation of cultural practices used in producing catfish in recirculation raceway systems. This study is still being carried on as additional facilities are added to the fish culture research facility at the Coastal Plain Experiment Station at Tifton, Georgia. The system layout is a closed-loop or recirculation system, consisting of a water reservoir or pond, a deep drilled well, a 550 gpm centrifugal pump, 6-inch cement asbestos water distribution pipe lines, flow meter, raceway, raceway inlet and raceway segments. Accessibility to the fish for carrying out feeding, sampling, treating and harvesting operations is provided by the raceway unit "pens". On the basis of one year's operation, this recirculation raceway system has proven to be an efficient and easily managed fish production system. However, there are some problems with the system. The major problem is maintaining water quality in a recirculation system that is used year after year. Further study is necessary to solve such problems and to keep the system economically practical. "Two-crop" fish production is one method of achieving this. (Kehl-East Central).

### 1996-A4, B1, B2, C2, D1, D2, D3, E2, E3, F2

### PROCESSING AND MANAGEMENT OF AGRICULTURAL WASTE

Cornell University
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, 540 p. 137 fig, 195 tab, 303 ref.

Descriptors: *Regulation, *Legal aspects, Effluent, Feedlots, Nutrients, Recycling
Identifiers: *Waste management, *Pollution, *Nonpoint sources, Refeeding, Land disposal

The purpose of this conference was to provide rapid and wide dissemination of information that would permit agriculture to continue to produce and process adequate quantities of food without causing environmental problems. Emphasis was placed on federal effluent guidelines and their effect on the livestock industry, control of nonpoint diffuse pollution sources, and waste stabilization, treatment, and disposal. (Merryman-East Central).

### 1997-A2, A4, A5, B1, F3

### METHODS FOR IDENTIFYING AND EVALUATING THE NATURE AND EXTENT OF NONPOINT SOURCES OF POLLUTANTS FROM AGRICULTURE

Midwest Research Institute, 425 Volker Boulevard, Kansas City, Missouri 64110
A. Aleti, S. Y. Chiu, and A. D. McElroy
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 10-23. 2 fig, 4 tab, 31 ref.

Descriptors: *Agriculture, *Analytical techniques, *Mathematical models, *Measurement, Pollutants, Pollution control, Agricultural runoff
Identifiers: *Nonpoint pollution

Nonpoint pollution from agriculture has been found to consist of some mix on nutrients (nitrogen and phosphorus especially), organic biodegradable matter, microorganisms, pesticides, mineral salts and sediment. Runoff water is the principal carrier of nonpoint pollution. Sensible planning for control of pollutant emissions from agriculture and of water quality in surface and underground streams and reservoirs requires quantitative knowledge of pollutant loads as functions of several factors. Nonpoint pollution modelling may help achieve this. Many parameters are involved in specification of nonpoint pollutant generation. These include: Basic characteristics of the land, land use, pollutant generation, pollution control, transport mechanisms, and dynamic features of receiving bodies of water. While models exist which measure individual aspects of the problem, a comprehensive model to do all these things does not presently exist in usable documented form. The overall basic need is development of comprehensive models which: (1) include all significant pollutants, but can treat each individually; (2) are sensitive to the causes (sources) of pollution and thus can provide the means to develop and assess various pollution control measures and strategies; and (3) recognize interdependencies between pollutants, such as pesticides and sediment, in order to facilitate development of simplified control measures. (Merryman-East Central).

### 1998-A4, A5, B2, F1, F2

### EFFLUENT REGULATIONS FOR LIVESTOCK AND POULTRY FEEDLOTS

Chief Impact Analysis Section,
Effluent Guidelines Division,
Environmental Protection Agency
Washington, D.C.
J. D. Denit
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 51-58. 4 tab, 2 ref.

Descriptors: *Economics, *Legal aspects, *Regulation, *Poultry, *Livestock, *Feedlots, Effluent, Water pollution control
Identifiers: *Guidelines, *Environmental Protection Agency

The Federal Water Pollution Control Act, as amended in 1972, defines concentrated livestock and poultry growing operations (feedlots) as "point" sources of "industrial" pollution and further requires that permits be issued for these operations. Until 1977, existing feedlot operations are to utilize, upgrade or install "in-being" pollution abatement facilities. Conversely, new feedlot installations must mandatorily utilize the latest techniques. Only by 1983 is enforced adoption of updated level of technology demanded of the total industry. This is considered to be a "reasonable" approach because the statute seeks to control and abate water pollution without diminution of a vital industry which has been contributing to mounting pollution problems. By evolutionized, as opposed to immediate, demands the statutory goal can and will be achieved. In this reasonable process, the individual operator, upon whom the vitality of a clean, efficient industry ultimately depends, will more certainly grasp his indispensable role in abating pollution. (Merryman-East Central).

## 1999-A2, A4, B2, F1, F2

### THE ECONOMIC IMPACTS OF IMPOSING EPA EFFLUENT GUIDELINES ON THE U. S. FED-BEEF INDUSTRY

Agricultural Economists, Commodity Economics Division, Economic Research Service,
East Lansing, Michigan
J. B. Johnson and G. A. Davis
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 59-70. 1 fig. 5 tab, 5 ref.

Descriptors: *Water pollution control, *Legal aspects, *Regulation, *Feedlots, *Cattle, *Economics
Identifiers: *Effluent guidelines, Environmental Protection Agency

The Federal Water Pollution Control Act Amendments of 1972 require that the discharge of pollutants into navigable waters be eliminated by 1985. Interim goals toward "zero" discharge are to be achieved by July 1, 1977, and by July 1, 1983. Effluent limitations for point source dischargers require the application of best practicable control technology currently available by 1977 and the application of the best available technology economically achievable by 1983. Thirty-five percent of those feedlots with dry-lot paved housing systems, because of their location in the Eastern States, are identified as having surface water control problems or potential. Twenty-six percent of those feedlots in the 18 states using open-lot systems have surface water control problems or potential. Of feedlots with dry-lot unpaved housing systems, 25 percent either have existing surface water control problems or the potential for runoff problems during and subsequent to a local 10-year, 24-hour storm. Implementation of announced EPA effluent guidelines could result in annual cost of increases which would severely encumber the economic viability of smaller-sized fed-beef operations with land-extensive housing systems located in humid production regions. Some operations may cease production. All feedlots which take actions to control runoff can expect lower returns on investments if production is continued at historical production levels. Improvements over time will depend upon changes in input prices and the price of beef marketed. (Merryman-East Central).

## 2000-A2, B2, B3, B4, E2, F1

### IMPLICATIONS OF EFFLUENT GUIDELINES AND OTHER POLLUTION CONTROL MEASURES ON DAIRY FARMS

Assistant Professor of Agricultural Economics, Cornell University, Ithaca, New York
D. Good, L. Connor, C. R. Hoglund and J. B. Johnson
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 71-85. 10 tab, 11 ref.

Descriptors: *Dairy industry, *Effluents, *Agricultural runoff, *Economics
Identifiers: *Pollution control, *Guidelines, Legal aspects, Land spreading

Physical and economic consequences are considered for the following kinds of pollution control measures that could be imposed on dairies: (1) mandatory control of surface runoff at the barnyard; (2) prohibition of winter spreading of dairy wastes; and (3) mandatory subsurface disposal of dairy wastes. Linear programming and partial budgeting techniques were employed to analyze these waste handling systems: (1) Stanchion housing — Gutter cleaner-spreader-daily hauling; (2) Open lot housing — Scraper-loader-spreader-daily scraping of alleys and scraping and hauling from lots; (3) Cold covered housing — Scraper-loader-spreader-daily hauling; (4) Warm enclosed housing — Tractor scraper-underground storage-liquid spreader; Mechanical scraper - underground storage - liquid spreader; or slotted floor underground storage liquid spreader. It was determined that: (1) Runoff control would most likely apply to open lot housing; (2) Prohibition of winter spreading and mandatory subsurface disposal would apply to all four types; (3) Economic impacts of compliance with all three control measures would be the worst for stanchion housing. Cold covered housing systems would be least affected if 6 month solid storage was allowed; (4) For farms with 80 cows, warm enclosed housing and a liquid manure system, investments for a soil injector and for increasing underground storage capacity to 6 months would increase 3 percent and monetary returns would be reduced by 14 percent. Added waste storage, if provided by less costly underground pump-outside storage system, would increase costs by $16 per cow and reduce operator returns by 10.7 percent. (Merryman-East Central).

## 2001-A2,A4,B2,B3,B4,E2,F1

### COST OF REDUCING SURFACE WATER POLLUTION FROM U. S. DAIRY FARMS

Agricultural Economist, Commodity Economics Division, Economic Research Division, Economic Research Service, Minnesota University, St. Paul
B. M. Buxton and S. J. Ziegler
Processing and Management of Agricultural-Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 86-96, 1 fig. 5 tab.

Descriptors: *Costs, *Water pollution, *Dairy industry, *Waste storage
Identifiers: Land disposal, Runoff control

Representative-size farms in 3 regions of the United States were selected to estimate individual and annual costs to (1) control runoff from exposed lots and wash water from the milking area, and (2) provide manure storage to avoid disposal on frozen ground. Results indicated that the greatest financial impact of controlling surface water runoff would be on dairy producers with fewer than 20 cows. Investment in lot runoff control facilities would be as much as $305 per cow, with annual costs as high as $82 per cow and milk produce costs increasing by as much as $0.68 per 100 pounds of milk. An additional investment of as much as $275 per cow for operators in the northern region would result if winter manure disposal was prohibited. The impact of controlling surface water runoff on farms with 20 or more cows is significant, but not as dramatic as the impact on smaller dairy farms. Total investment for runoff control for United State's dairy producers with a runoff problem would be about $333 million. By exempting producers with less than 20 cows, investment would be reduced to $225 million. If all herds with less than 100 cows were exempted, investment would drop sharply to $25 million. Investment in manure storage facilities would be as much as $768 million, but would drop to $35 million if farms with less than 100 cows were excluded from complying with future winter disposal guidelines. Total cost to the dairy industry to both control lot runoff and avoid spreading on frozen land would be over $1 billion. If farms with less than 100 cows were excluded, total investment would be reduced by almost 95 percent to approximately $61 million. (Merryman-East Central).

## 2002-A2, A4, B2, F2, F3

### ECONOMIC IMPACT OF CONTROLLING SURFACE WATER RUNOFF FROM POINT SOURCES IN U.S. HOG PRODUCTION

Agricultural Economist, Commodity Economics Division, Economic Research Service, U.S. Department of Agriculture
R. N. Van Arsdall
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 97-107.

Descriptors: *Economics, *Agricultural runoff, *Water pollution control, *Regulation
Identifiers: *Hog production

This economic impact analysis is limited to examination of prevention of surface water pollution by contaminated runoff from concentrated systems of production. This analysis began before the announcement of the EPA's proposed effluent guidelines of September 7, 1973, but the conclusions are still pertinent. Hog production is largely in the hands of small volume production. Producers turning out fewer than 200 hogs a year make up a third of total production in the 15 major hog producing states. Thus strict runoff control regulations would very likely put many pork producers out of business due to excessive financial burden. The remaining hog producers then would have to take up the slack in hog production. They could do this only after a period of adjustment. In the meantime, these larger producers could probably make the needed changes without much increase in pork prices for the consumer. What would cause an increase in the price of pork is the shortage of pork during the adjustment period. Desirable outcome in the changes ahead would be augmented by the following: (1) Specifics of regulations and timing of their application should be made known as soon as possible: (2) Regulations should be phased into the industry over a period of years: (3) Most producers of moderate size may be able to absorb additional costs per 100 pounds of pork produced and to continue production on a competitive basis. However, many may not. Thus, there may be a need to allow more time for adjustment or to provide a cost-sharing to meet their needs. (Merryman-East Central).

## 2003-A1, A4, A5, A7, A8, A13, B1

### AN ENVIRONMENTAL ANALYSIS OF FEEDLOT SYSTEMS

C. N. Ifeadi and W. T. Lawhon
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 108-121. 6 fig. 13 ref.

Descriptors: *Feedlots, *Systems analysis, *Environmental effects
Identifiers: *Pollution

The purpose of this paper was to suggest a methodology whereby feedlot systems could be analyzed for potential environmental impacts. The balance between the constituents necessary for maximum production and the capacity of the environmental components to withstand pollution was analyzed. This was done by compiling a simple checklist, arranged in matrix form, and developed so that the potential interactions between the various components of the feedlot system and its environment could be identified. Feedlot systems and processes were listed with corresponding pollution impacts for (1) surface-water pollution, (2) groundwater pollution, (3) air pollution, (4) land pollution, and (5) aesthetic and human factors. Further studies will be required in order to develop data which will verify the simple mathematical models put forth in this paper and in order to determine the magnitude of the impacts shown in the matrix. (Merryman-East Central).

## 2004-B3, D2, E2, F1
### COMPLETE SYSTEM FOR COLLECTING, HANDLING, AIR-DRYING AND MACHINE DEHYDRATION OF POULTRY MANURE IN A CAGED LAYER PRODUCTION UNIT

Department of Poultry Science, Michigan State University, East Lansing
C. J. Flegal, M. L. Esmay, J. B. Gerrish, J. E. Dixon, C. C. Sheppard, H. C. Zindel and T. S. Chang
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 122-131. 1 fig, 7 tab, 5 ref.

Descriptors: *Excetra, *Drying, *Economics, *Design
Identifiers: *Waste handling, *Caged layer production unit, Energy requirements

This demonstration project was undertaken to design, construct and test a poultry laying house that would incorporate a complete system for waste removal, dehydration and refeeding to poultry and other livestock. Specific objectives were: (1) to demonstrate and evaluate a complete excreta handling system including in-house drying and dehydration, (2) to determine optimum dehydration conditions for the multiphase drying system, (3) to minimize energy requirements, (4) to make the system adaptable to most existing commercial egg producing units, (5) to determine emissions from the system, and (6) to determine the economics of the system. The project's clear span pole and truss building utilized a continous conveyor belt drying tunnel and afterburner in drying the excreta. Fuel consumption, electrical inputs, air movement, and relative humidity were monitored. Different months yielded different results. In February the dryer reduced excreta moisture content to about 1 percent. Fuel consumption was between 2.45 and 2.83 gallons per hour for the dryer and 2.02-2.65 gallons per hour for the afterburner. The water removed by the dryer was 172-191 per hour (a BTU requirement of 2500-4500 Btu per lb. of water removed). Over half the fuel requirement was for the dryer; the rest was for the afterburner. Approximately 9 percent of the water was removed by ventilation, 3 percent in the tunnel, and 6 percent in the dryer. (Merryman-East Central).

## 2005-B2, D3, E2, E3, F3
### INTEGRATED POULTRY-MANURE HANDLING USING FLUSH TRAYS UNDER CAGES AND RENOVATED WASTEWATER: AN IN-PROGRESS REPORT ON AN 1100-BIRD LAYER HOUSE

Agricultural Engineering Department, Georgia Coastal Plain Equipment Station, Tifton
C. V. Booram, D. S. Bundy, G. B. Parker and R. L. Fehr
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 132-140. 5 fig, 2 tab, 15 ref.

Descriptors: *Poultry, *Excreta, *Hydraulic transportation, Sprinkler irrigation, Lagoons
Identifiers: *Waste recycling, Feathers, Aerobic lagoon, Land disposal

Hydraulic handling of poultry manure is being tested at Iowa State University. Half of a 2200-bird laying house was renovated and is not operating as a flushing system. When the system is complete, aerobic-lagoon water will transport the manure. Temporarily, fresh water is being used. This modified system includes flushing tanks, flushing trays fabricated and formed from 12 gauge steel with an epoxy coating, and the necessary controls and equipment to process, treat, recycle, and dispose of manure and feathers. Wastes in the flushing channels are hydraulically transported to a chopper pump where they are chopped and recycled with the water for channel flushing. Periodically, the manure and feathers are discharged through a sewer line into the anaerobic cell of a two stage lagoon. Future waste-management plans include evaluation of odor reduction, labor reduction, and management problems. Different flushing and discharge intervals will be used to determine the optimum system management. (Merryman-East Central).

## 2006-A11,B1,B3,C1,C2
### CHARACTERIZATION OF WHITE LEGHORN MANURE

Agricultural Engineering Department, Cornell University, Ithaca, New York
A. G. Hashimoto
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 141-152, 7 fig, 6 tab, 8 ref.

Descriptors: *Feeds, *Mortality, Moisture content
Identifiers: *White leghorns, *Manure, *Egg production, *Waste characteristics

Laying hens were placed in conventional stair-step cages when about 21 weeks old to begin their laying cycle. They were removed after 11 or 12 months of egg production. Data on feed consumption, egg production and bird mortality were recorded in an attempt to determine the variations in production and characteristics of laying-hen manure as related to diet, feed consumption, bird age, and egg production. Diet consumed had significant influence on manure production. Hens fed the Practical (Basal) Diet, with no additives, 0.2 percent DL-Methionine, 0.2 percent choline chloride (70 percent), or both 0.2 percent DL-Methionine and 0.2 percent choline chloride (70 percent) produced 37 percent more manure and 43 percent more moisture than those fed the Random Sample Diet. This effect of diet would be a significant management constraint, especially for operations utilizing "dry" manure-handling systems. Mass balances of feed consumption and manure production showed that approximately 35 percent of the total solids, 30 percent of the volatile solids, 70 percent of the fixed solids, 35 percent of the COD, and 80 percent of the total nitrogen consumed were recovered in White Leghorn manure. (Merryman-East Central),

## 2007-B1, C2
### THE PRODUCTION RATE AND COMPOSITION OF MANURE FROM GROWING TURKEYS

Animal Sciences Department, Purdue University, West Lafayette, Indiana
J. G. Berry, A. L. Sutton and J. R. Carson
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 153-158. 1 fig, 2 tab, 9 ref.

Descriptors: *Nutrients, *Analysis
Identifiers: *Manure, *Production rate, *Composition, *Turkeys

The purpose of this study was to determine the amount and composition of manure produced by growing turkeys under current confinement management practices. Average daily production rate (wet basis) was determined to be 0.64 pounds per bird per day for the males and 0.53 pounds per bird per day for the females. Mean values of nutrients for all samples regardless of sex was determined by chemical analysis (wet basis). Nitrogen, phosphorus, and potassium were 1.36 percent, 0.49 percent, and 0.71 percent respectively, (Merryman-East Central).

## 2008-B2,B3,B4,C3,D1,D3
### AIRBORNE MICROORGANISMS IN HIGH DENSITY POULTRY MANAGEMENT SYSTEMS

Department of Food Science, Cornell University, Ithaca, New York
S. Sotiracopoulos and N. C. Dondero
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 159-174. 6 fig, 7 tab, 30 ref.

Descriptors: *Poultry, *Air pollution, *Microorganisms, Pathogenic bacteria
Identifiers: *Waste management, *Oxidation ditch, *Undercage drying pit, Staphylococcus aureus, Salmonella typhimurium

An investigation was undertaken to: (1) estimate the total number of microorganisms and staphylococcus aureus per $ft^3$ of air in four chicken growth chambers, (2) Demonstrate the dispersal of microorganisms into the atmosphere of the chicken growth chamber (due to aerosal formation from the "oxidation ditch"), (3) identify the isolates from air samples, (4) estimate the number of staphylococcus aureus and salmonella in the wastewater of the "oxidation ditch", and (5) study the survival of staphylococcus aureus and salmonella typhimurium inoculated in the wastewater at the "oxidation ditch". The waste treatment systems used in the investigation were: oxidation ditch, diffused aeration ditch, undercage drying pit (with slot outlet), and undercage drying pit (high-rise). Specific results are tabulated. Density of microorganisms varied widely and the density was influenced by type of waste treatment system. It was found that the oxidation ditch dispersed the highest number of microorganisms in the air. (Merryman-East Central).

## 2009-A3,A4,A8,C2,E2,F6
### EFFECTIVENESS OF NITROGEN CONTROL IN POULTRY WASTE MANAGEMENT AS ESTIMATED BY SIMULATION MODELING

Manitoba University, Winnipeg, Canada
D. D. Schulte, R. C. Loehr, D. A. Haith and D. R. Bouldin
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 189-199. 7 fig, 2 tab, 15 ref.

Descriptors: *Computer models, *Mathematical models, Poultry, Water pollution, Leaching, Agricultural runoff
Identifiers: *Nitrogen control, *Waste management, Land spreading

Nitrogen management on a hypothetical poultry farm was computer simulated and a comparison was made of nitrogen losses to ground and surface water resulting from various waste management policies. Utilization of the mathematical model revealed the following: (1) leaching of inorganic nitrogen from manured fields was reduced more at equivalent removal levels followed by high application rates than at lower disposal rates; (2) confinement of manure disposal to the time preceding planting (April 1-May 20) and rates of 250 kg/ha or less, and/or removal of the majority of inorganic nitrogen prior to spreading reduced the inorganic nitrogen levels in the soil at the onset of winter to approximately that remaining where no manure was applied. (Additional research is needed to verify this.); (3) residual inorganic nitrogen in the soil at the onset of winter was affected more by nitrogen removal prior to disposal than by the application rate; and (4) most of the nitrogen lost in runoff from manured fields due to rainstorms occurring between April 1 and November 30 was carried in water from one or two storms. Due to the variability of runoff occurrences, scheduling manure disposal at different times within this period will not reduce runoff losses consistently over a number of years. (Merryman-East Central).

## 2010-A3, C2, F1, F2

### AN ECONOMIC ANALYSIS OF POLICIES TO CONTROL NUTRIENT AND SOIL LOSSES FROM A SMALL WATERSHED IN NEW YORK STATE

Department of Agricultural Economics, Cornell University, Ithaca, New York
W. H. Schaffer, J. J. Jacobs and G. L. Casler
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 200-210. 3 tab, 8 ref.

Descriptors: *Model studies, *Economics, *Water pollution control, Nutrients, New York
Identifiers: *Soil loss, Watershed, Effluent taxes, Fertilizer taxes

A watershed model was developed which incorporated both estimated losses of nitrogen, phosphorus, and soil and the costs to the farmers in reducing these losses. The following three policies for controlling losses and measuring the effect on farm income in the watershed were evaluated: (1) restrictions on losses; (2) effluent taxes; and (3) fertilizer taxes. Costs to farmers in using any of these methods would be substantial. While (1) and (2) would be hard to administer, (3) would most likely be ineffective in reducing the losses of pollutants. The model did not evaluate the possibility of reducing losses by methods other than changes in crop and livestock production. Further research is needed. (Merryman-East Central).

## 2011-A3, B1, C2, E2

### LAND DISPOSAL PARAMETERS FOR DAIRY MANURE

Agronomy Department, Cornell University, Ithaca, New York
P. J. Zwerman, S. D. Klausner and D. Ellis
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 211-221. 7 tab, 17 ref.

Descriptors: *Dairy industry, Nutrients, Sediment transport, Agricultural runoff
Identifiers: *Manure, *Land spreading, *Loading rates

Researchers wanted to ascertain the effect of winter spreading, spring plow down and summer topdress methods on resulting nutrient and sediment losses. Dairy manure was applied at loading rates of 15, 45, and 90 tons per acre on land used for continuous corn production. Two systems of soil management were used. Removal of all plant residues at harvest was denoted as poor management. Reincorporation of plant material into the soil was considered good management. The following conclusions were made: (1) The greatest nutrient loss results when cow manure is spread on top of melting snow that is situated on frozen soil. Manure spread on frozen soils and later covered by snow does not result in excessive losses; (2) Even under such extreme conditions, substantial reductions in losses can be produced by lowering the loading rate and/or improving the soil structure through soil management. Even when spreading under adverse weather conditions, a 2/3 reduction in nitrogen and phosphorus losses to the environment was achieved by maintaining soil structure by return of residues; (3) Hurricane Agnes — 6.84" rain — was the most effective means of moving sediment. These sediments were lower in nutrients than the runoff waters; and (4) A high-intensity storm of 2.45 inches in August, 1972, removed little sediment and few nutrients. It was felt that this was due to the protective action of the nearly fully grown corn crop. (Merryman-East Central).

## 2012-A2,B1,E2,F1,F2,F6

### BEEF WASTE MANAGEMENT ECONOMICS FOR MINNESOTA FARMER-FEEDERS

Agricultural Economics Department, California State University, Fresno
C. L. Pherson
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 250-270. 1 fig, 13 tab, 13 ref.

Descriptors: *Minnesota, *Regulation, *Economics, *Costs, *Model studies
Identifiers: *Waste handling, Runoff control, Crop selection

This study was performed to develop a method for determining optimal farmer response to Minnesota pollution regulations. Objectives included determination of (1) direct and indirect costs of complying with regulations, (2) net return maximizing alternative systems, (3) optimal time schedules for waste handling, (4) marginal value or cost of beef wastes, and (5) effects of system choice on field crop selection and crop operation timing, and the effects of set-aside acres or rotating disposal field. It was found that a programming model could accomplish these goals. Specific figures are tabulated for various alternatives. Pollution control consultants should consider alternative waste handling-housing systems in terms of farm-feedlot profit before recommending runoff control structures on current facilities. (Merryman-East Central).

## 2013-A1, B2, B3, F1

### ENERGY AND MONETARY COSTS FOR TWO BEEF CATTLE WASTE DISPOSAL SYSTEMS

Assistant Professor of Agricultural Engineering, VPI/SU, Blacksburg, Virginia
H. A. Hughes, J. B. Holtman and L. J. Conner
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 271-282. 9 fig, 4 ref.

Descriptors: *Energy, *Costs, *Waste disposal, *Liquid wastes, *Solid wastes, *Mathematical models

A method was presented for determining the cost of energy to produce beef. The method was explained by use of an example beef feeding farm. The two alternatives that were considered were liquid waste handling and solid waste handling. Analysis was carried out by using a mathematical model based on the 'energy structures' technique. This technique is based on the systems concept of a set of components interacting through mass and energy exchanges among themselves in the environment. Equivalent network models then describe the complete system. Evaluations include the determination of energy cost of beef production and material flows into, out of, and within the system. It was found that liquid waste handling required larger amounts of capital, fossil energy, and labor than similar systems using solid waste handling. However, solid waste handling had greater nutrient loss to the environment. (Merryman-East Central).

## 2014-B5, C1, C2

### INFLUENCE ON FEEDING SYSTEM, DIGESTIBILITY OF RATION AND PROPORTION OF CONCENTRATE CONSUMED ON THE QUANTITY AND QUALITY OF EXCRETA VOIDED BY LACTATING COWS

Animal Research Institute, Research Branch
Agriculture Canada, Ottawa, Ontario K1A 0C6
L. J. Fisher
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 283-290. 5 tab, 5 ref.

Descriptors: *Feeds, Moisture content, Nutrients
Identifiers: *Feeding systems, *Digestibility, *Excreta, *Lactating cows

The quantity and characteristics of the manure produced from various feeding systems should be stated with greater precision. In an attempt to provide more comprehensive information as to quantity, moisture content, and nitrogen content of excreta, the results of approximately 400 digestibility trials conducted with lactating cows are summarized. If the refinement of predicting manure characteristics is considered to be warranted, then computer capabilities should be sufficient to formulate that bulk of data into meaningful guidelines. (Merryman-East Central).

## 2015-A6, A7

### A PRACTICAL PORTABLE METHOD OF ODOR MEASUREMENT

University of Kiel, Germany
H. Mannebeck
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 291-294. 3 fig.

Identifiers: *Odor measurement, *Olfactometer

The difficulty in making valid odor measurement is discussed. Because odor is not definable as a physical dimension, subjective organoleptic procedures must be used in its measurement. A certain objectivity is made possible by using olfactometers. The olfactometer has mainly been developed and designed for judgement of odor from animal production farms including storage, treatment and hauling of liquid manure. Using this equipment, odor loaded air will be mixed with odorless air to such a degree that odor can just be distinguished. The amount of dilution is used as a measure for the intensity of the air. During the testing process, there is almost no acclimatization to the odor because of light odor intensities. Furthermore, regeneration of the sensitivity of the nose takes place between measurements. Errors in measurement that can occur are: (1) Errors in measurement and calibration during determination of flow volume. (2) Errors due to temperature decrease. (3) Errors due to so-called effect of refreshness. (4) Loss of odor loaded particles due to adhesian inside the instrument. (5) Errors due to adaption. (Merryman-East Central).

## 2016-A6,B2,C1,C2,D1,D3,F1

### THE HANDLING AND TREATMENT OF MINK WASTES BY LIQUID AERATION

Monteco Environmental Management Associates, Montgomery, New York
A. C. Anthonisen and R. C. Loehr
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 295-308. 10 fig, 8 tab, 9 ref.

Descriptors: *Mink, *Design, Economics
Identifiers: *Waste handling, *Liquid aeration, *Oxidation ditch, Jet-Aero-Mix System, Odor control

Results of laboratory and full scale experiments indicated that liquid aeration was feasible for handling and treating wastes of mink raised in enclosed sheds. The study indicated that wastes from the confined mink could drop into an in-house oxidation ditch and that offensive odors could be eliminated. Treatment efficiencies indicated that the microorganisms within the mixed liquor could remove 46% TS, 93% TKN, and 97% BOD. Foaming occurred but was not considered a problem. Better design was found to be needed to reduce odor control costs. Clogged nozzles due to hair and straw was a problem when using the Jet-Aero-Mix system. Other aeration alternatives are available, but the concept of liquid aeration itself does appear to be a workable one. (Merryman-East Central).

### 2017-A4, A9, B1, F3
### EUROPEAN APPROACHES TO THE CONTROL OF WASTE POLLUTION PROBLEMS CAUSED BY AGRICULTURAL WASTES AND FERTILIZERS

Agricultural Engineer Non-Point Pollution Control Division, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D. C. 20460
W. C. LaVeille
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 320-335. 8 tab.

Descriptors: *Water pollution control, *Europe, *Fertilizers, Pesticides, Forest Management, Nutrients
Identifiers: *Agricultural wastes

A seminar was held in Vienna, Austria, during October, 1973, to discuss pollution of waters by agriculture and forestry. In general, the discussions paralleled conferences on similar topics held in this country. The major differences related to European agricultural practices themselves such as the relative scarcity of feedlot operations of a size comparable to those found in the United States and the generally higher proportion of European land used for intensive agricultural production. Experts found it difficult to quantify at the country or regional level the degree of water pollution due to livestock production because specialized literature was scarce and no in-depth studies of the problem as a whole could be found. Use of fertilizers and pesticides was also discussed. The seminar drafted and approved recommendations that programs be established to: (a) encourage farmers and foresters to use suitable methods to help minimize the transport of nutrients to water bodies; (b) monitor the effects of agricultural and silvicultural activities on the waters, for assessing the share of these activities in total water pollution and estimating future tendencies in the evolution of such pollution; (c) follow with attention the recent trends in the use of fertilizers in forestry in order to avoid that forestry should become a significant source of pollution by plant nutrients; (d) promote research on such problems as the rate of transfer of nutrients through the soil, taking into account the many factors on which this rate depends. (Merryman-East Central).

### 2018-A11, A12, B3, B5, D3, E3, F1
### BEEF FEEDLOT WASTE IN RATIONS FOR BEEF CATTLE

Department of Animal Science, California State Polytechnic University, Pomona
T. W. Westing and B. Brandenberg
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 336-341. 8 tab, 3 ref.

Descriptors: *Cattle, *Diets, *Performance
Identifiers: *Refeeding, *Manure

To assess the feasibility of recycling beef feedlot wastes, a feeding trial was conducted comparing a typical feedlot ration with an experimental ration consisting of 14 percent composted beef waste. Thirty steers were test fed for 184 days. Average daily gain (kg), feed consumption (kg), feed conversion (kg), cost/kg gain (c), were 1.10, 8.66, 7.87, .7711; 1.11, 8.25, 7.43, .8440 for the waste added and control groups, respectively. The closeout on the beef waste group was $14.87 less per head for the total feeding period. No significant difference was found in carcass yield, quality, or taste for the two groups tested. (Merryman-East Central).

### 2019-B5, C1, C2, C3
### THE EFFECT OF RATION ON MATERIAL HANDLING AND PROCESSING METHODS OF BEEF CATTLE MANURE

Agricultural Engineers, Agricultural Research Service, U. S. Department of Agriculture, Nebraska University, Lincoln
C. B. Gilbertson, and J. A. Nienaber
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 342-355. 5 fig. 5 tab, 11 ref.

Descriptors: *Cattle, *Design, *Diets, Physical properties, Chemical properties, Biological properties
Identifiers: *Waste handling, *Manure, *Ration

The effects of three ration roughage contents on beef cattle wastes were determined in order to gather design information necessary for handling, conveying, and processing beef cattle wastes. The most significant effects of roughage content were on physical properties, production, total solids content, particle size, distribution, apparent viscosity, flow properties, compaction, and shrinkage factors. Volatile solids, specific gravity, and wet bulk density were least affected. Specific conclusions are stated. It was determined that the designing of waste management system components will depend on the changes in physical properties which are affected by ration roughage content. (Merryman-East Central).

### 2020-A11,B2,C3,D3,E3,F3
### INFLUENCE OF INGESTION OF ANAEROBIC LAGOON EFFLUENT ON GROWING SWINE

John Deere and Co., Dubuque, Iowa
L. W. Schmitt, T. E. Hazen and R. J. Smith
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 356-374. 19 fig. 7 tab, 14 ref.

Descriptors: *Recycling, *Pathogens
Identifiers: *Anaerobic lagoon effluent, *Swine, *Ingestion, *Waste water

Because water may serve as a transport medium for many disease organisms, this study was concerned with the health of swine exposed to recycled lagoon effluent. An experiment was conducted which had three major variables: (1) animal exposure to the flush liquid, (2) type of flush liquid (fresh water or recycled anaerobic-lagoon water), and (3) the use of the two liquids in the drinking fountains. Also compared in the experiment were two swine feeding systems — on-floor and self-feeder. Overall, the experiment reinforced the belief that use of anaerobic-lagoon water in open-channel manure-handling systems does not degrade animal performance. Necropsy results showing degradation (hyperplasia) of the lymph nodes were not considered cause for alarm because the exposure to the lagoon water was extreme, since the pigs were forced to drink it as their only source of water. Future experimentation should include the following: (1) forced ingestion of recycled lagoon effluent during the full reproductive cycle, (2) injection of known enteric pathogens into the system, (3) use of more replicates to determine if feed efficiency is affected by ingestion of the gutter contents, (4) more detailed analysis of physiological changes such as white blood cell counts, antigen response, antibody titer, etc. and (5) evaluation of pulmonary irritation caused by gases. (Merryman-East Central).

### 2021-B2, B5, C2, D3, E3
### NUTRITIVE VALUE OF AMINO ACID PRODUCED IN AN OXIDATION DITCH FROM WASTE

Department of Animal Science,
Illinois University
B. G. Harmon and D. L. Day
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference; Rochester, New York, March 25-27, 1974, p. 375-381. 2 fig. 8 tab, 11 ref.

Descriptors: *Proteins, *Amino acids, *Feeds
Identifiers: *Swine, *Feces, *Oxidation ditch mixed liquor

Microbiota in intestines and excreted feces are very effective in bio-upgrading nitrogen containing byproducts and endproducts of metabolism into single cell proteins and amino acids. The oxidation ditch provides a compact, economical, and efficient system in which this bioenhancement may take place. The amino-acid rich product may then be used as a supplement for swine diets. Feeding systems using oxidation ditch mixed liquor can utilize all the waste produced by swine. (Cameron-East Central).

### 2022-B2, D3,
### BEEF OXIDATION DITCH SETTLED SOLIDS FED TO STEERS

Agricultural Engineer, NCR-ARS-USDA
R. O. Hegg, J. C. Meiske, R. E. Larson, and J. O. Moore
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 382-386. 3 tab.

Descriptors: *Feeds, *Cattle, *Solid wastes, Performance
Identifiers: *Refeeding, *Oxidation ditch

Research was conducted to determine the feeding value of solids recovered from an oxidation ditch and refed to finishing steers as part of a ration. Twenty Holsteins were randomly allotted to five lots of four steers each. Regular air-dry, shelled corn was used as the control ration, with two rations containing different ration of reclaimed solids and corn. Because reclaimed solids were wet rations, water was added to two of the control rations to give similar moisture content. The 84-day feeding trial revealed that feeding reclaimed solids will not have a significant effect on the average daily gain of finishing steers if fed at rates up to one part corn: two parts reclaimed solids from an oxidation ditch. The reclaimed solids had 63 to 85 percent of the feeding value of regular air-dry corn on a dry matter basis. Reclaiming solids and refeeding them seems feasible; but if the system is used in open feedlots in cold regions of the United States, freezing problems due to the moisture content of the feed can be expected. (Merryman-East Central).

### 2023-A11, B3, D3, E3
### A FUNDAMENTAL APPROACH TO ANAEROBIC LAGOON ANALYSIS

Agricultural Engineering Department, Clemson University, Clemson, South Carolina
D. T. Hill and C. L. Barth
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 387-404. 13 fig. 7 tab, 18 ref.

Descriptors: *Mathematical models, *Analysis, *Design criteria
Identifiers: *Prediction, *Anaerobic lagoons, Swine

Operating parameters such as loading rates, detention times, and depth have been investigated without really considering—more basic operating characteristics. Because chemistry of the wastes, stoichiometry, dynamics, and kinetics as well as microbiology of the reactions are all fundamentally inherent in the process, a mathematical model was developed to interface all these fundamental characteristics in an attempt to provide basic understanding of the overall process. General trends for anaerobic lagoons treating swine wastes were predicted. Because the parameters for this study were based upon the literature concerning conventional anaerobic digestion processes, as opposed to kinetic parameters, errors may have occurred. The model was meant to be only a first approximation. Refinement of the model through further studies should provide better correlations. (Merryman-East Central).

### 2024-B2,B5,C2,D3,E3,F1
### TREATMENT OF BEEF WASTE BY A ROTATING BIOLOGICAL CONTACTOR

Agricultural Engineering Department,
Minnesota University, St. Paul 55101
J. A. Moore, R. O. Hegg, and R. E. Larson
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 405-414. 5 fig. 3 tab, 5 ref.

Descriptors: *Aerobic treatment, *Liquid wastes, *Cattle, *Recycling, Effluent, Costs, Analysis
Identifiers: *Rotating Biological Contractor

A Bio-Disc for treatment of liquid beef waste in a closed recycling system was evaluated. The unit consisted of a series of discs mounted on a horizontal shaft and suspended over a semicircular tank. The discs rotated slowly with about half of their surface intermittently exposed to liquid and to air. An aerobic bio-mass developed and grew on the disc. The bio-mass consumed organic matter in the waste water and utilized oxygen from surrounding air to maintain aerobic conditions. The liquid waste flowed progressively through four states, and then into a clarifier section where settleable solids settled out. Effluent from the clarifier section then flowed to a wet well and was pumped to the elevated flush tanks to repeat the cycle. Sample analyses were made for: chemical oxygen demand, biochemical oxygen demand, total solids, total volatile solids, phosphorus, chloride, ammonium nitrogen, organic nitrogen and pH. The Rotating Biological Contactor (RBC) removed 18 pounds of BOD$_5$ per day when receiving a primary clarifier effluent averaging 6006 mg/1 of BOD$_3$, COD, PO$_4$ and organic nitrogen concentrations were 3 times higher on the sludge than in the RBC effluent. The pH values of the sludge were the lowest of those samples taken. The TVS as a percent of TS averaged 80% for the sludge and 70 to 73% for all other samples. Crystalline buildup on the discs interfered with bacterial growth. Based upon a cost of 30c per square foot of surface area installed disc, as estimated by Autotrol, the initial and operating cost of the RBC will not allow its widespread application to high organic strength animal waste waters. (Merryman-East Central).

### 2025-B2, B5, C2, D3, E3
### WASTE TREATMENT WITH A PROTEIN BONUS

Bacteriology Division, School of Agriculture, Aberdeen, Scotland
K. Robinson
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p 415-420. 3 fig. 2 tab, 8 ref.

Descriptors: *Aerobic treatment, *Proteins, Nitrification, Denitrification, Sludge, Copper, Swine
Identifiers: *Oxidation ditch, Anaerobic lagoons, Loading rates, Refeeding, Nucleic acid

An oxidation ditch was filled with anaerobic lagoon supernatant in order to determine: (1) loading rates of an oxidation ditch treating supernatant from an anaerobic lagoon, (2) feasibility of controlled simultaneous nitrification-denitrification, and (3) yield and protein value of sludge produced during aerobic treatment. After the initial start-up period the ditch was operated on a cycle of no aeration for one hour to allow sludge settling and the removal of a volume of supernatant equivalent to the input, agitation during addition of lagoon liquor, no aeration for 4-5 hours to permit denitrification to this cycle was the removal of mixed liquor instead of settled supernatant for approximately one month. Lagoon, oxidation ditch, and final settling tank samples were examined for total and dissolved COD, pH, NH$_4$+/−N NO$_2$-N, and NO$_3$-N as frequently as possible (usually daily). Measurement of other parameters were also made. Microbial sludge harvested by centrifugation from oxidation ditch mixed liquor was analyzed for KJN, total and available lysine. Experimental results demonstrated that loading based on volume was only satisfactory if quality of input remained the same. Sludge protein may be of value for refeeding; however, copper and nucleic acid content may make such refeeding unsuitable. Further research is needed. Estimates of yield were 1 kg dry solids/ 100 pigs. (Merryman-East Central)

### 2026-B2, C2, D3
### APPROACHES FOR THE CONTROL OF NITROGEN WITH AN OXIDATION DITCH

Department of Agricultural Engineering, Cornell University, Ithaca, New York
T. B. S. Prakasam, E. G. Srinath, A. C. Anthonisen, J. H. Martin, Jr., and R. C. Loehr
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 421-435. 5 fig, 10 tab, 14 ref.

Descriptors: *Nitrogen, *Control, Poultry
Identifiers: *Oxidation ditch, Odor control

A pilot scale oxidation ditch was used to demonstrate several approaches for controlling nitrogen in poultry wastes. The following models of operation were used: (1) continuous rotor operation without intentional wasting of mixed liquor, (2) maintenance of a solids equilibrium condition by intentionally wasting some mixed liquor and subjecting the remaining mixed liquor to intermittent denitrification, (3) maintenance of solids equilibrium and using a solids separation tank to settle the mixed liquor suspended solids and to denitrify the recycled effluent, and (4) intermittent periods of rotor aeration which permitted nitrification and denitrification. Results of the study indicated that as much as 70 percent of the input nitrogen to the oxidation ditch could be conserved and up to 90 percent of it could be removed, depending on the mode of operation chosen. The study also indicated that waste stabilization and odor control need not be sacrificed when controlling nitrogen. (Merryman-East Central).

### 2027-B2, B5, D1, D3, F6
### OXIDATION DITCH SYSTEM ANALYSIS AND FIELD EVALUATION OF THE AEROB-A-JET

Universitaet Bonn, Institute fuer Landtechnik, Nuss-Allee
D, Simons, D. D. Jones, and R. C. Dale
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 436-454. 3 fig, 3 tab, 39 ref.

Descriptors: *Analysis, *Design, *Aeration
Identifiers: *Oxidation ditch, *Aerob-A-Jet

A critical analysis was given of the oxidation ditch system and its current design practices in connection with various aeration devices. Treatment efficiency, heat production and conservation, and solids liquid separation were examined in relation to different oxidation ditch systems. A field evaluation of the Aerob-A-Jet revealed that certain modifications must be made before it will operate optimally. The following conclusions concerning oxidation ditch design were stated. (1) Oxidation ditches should use channel cross sections which optimize flow properties and therefore decrease energy requirements for circulation and mixing. (2) Biological oxidations in the ODML produce a great deal of heat which should be conserved with the use of the proper aeration device. This would help prevent freezing in cold weather and the lower viscosity would decrease energy requirements for circulation and mixing. (3) The separation of large solids from the ODML would greatly enhance waste treatment, lower energy requirements for aeration and circulation, and decrease the problem of final disposal of the waste. (4) Liquid circulation and aeration should be accomplished by separate devices for maximum efficiency. (5) A ditch Reynolds number of at least 10,000 should be maintained if maximum treatment efficiency is to be achieved. (Merryman-East Central).

### 2028-A8,B2,C2,D1,D3,E2
### AEROBIC STABILIZATION AND LAND DISPOSAL OF LIQUID SWINE MANURE

University of Kiel, Germany
U. Riemann
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 455-463. 6 fig, 3 tab,

Descriptors: *Aerobic treatment, *Swine, Fertilizers, Bacteria
Identifiers: *Land disposal

A plant for aerobic biological treatment of liquid swine manure was built at Kiel University in order to clarify the material for release into a water course. During the tests, the goal changed to deodorizing and pasteurizing the manure. The multi-step research plant consisted of two isolated aeration tanks and a flotation reactor with an adjustable foam overflow leading to a foam drying bed. The aeration tank had a second outlet leading the liquid to a three-chamber sedimentation tank. The plant utilized swine manure with 6-8 percent dry matter contents which was treated in a batch and partly in a continuous flow system. The decomposition efficiency of the plant averaged 40 percent. The foam drying bed did not operate successfully due to a thin gelatinous layer buildup. It was found that sedimentation of solids going with the liquid phase from the flotation tank continuously into and through the sedimentation tank, could not be arranged successfully. Batchwise treated manure became odor free after seven days of treatment and remained so for two weeks. The continuous flow systems had quicker results but required more equipment. Bacteriological investigations with salmonella bacteria indicated that the bacteria were dead within six hours of their introduction into the reactor at temperatures around 40 degrees C. Crop yield from land fertilized with treated manure and land fertilized with untreated manure was about the same. Aerated liquid manure caused less corrosion damage when spread on plants. Biological aerobic treatment of manure will result in longer manure hauling periods. (Merryman-East Central).

### 2029-A8, B3, E2
### FORAGE AND GRAIN PRODUCTION FROM LAND USED FOR BEEF MANURE DISPOSAL

Agricultural Engineering Department, Texas A&M University, College Station
D. L. Reddell
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 464-483. 14 fig, 5 tab, 18 ref.

Descriptors: *Productivity
Identifiers: *Land disposal, *Deep plowing, *Application rates

A study was conducted at El Paso and Tulia, Texas to evaluate deep plowing of large amounts of manure into the land. At El Paso, manure was applied to Vinton fine sandy loam in April, 1970, at rates of 0, 672, 1345, and 2017 mtons/ha. The manure was deep plowed into the soil by using a 76-cm moldboard, a 46-cm moldboard, and a 69-cm trencher machine. At Tulia, manure was applied to Pullman clay loam at rates of 0, 22, 56, 112, 224, 336, and 672 mtons/ha in August, 1971, and February, 1973. In addition, manure was applied at rates of 1345 and 2017 mtons/ha in August, 1971, only. The 22, 56, and 112 mtons/ha plots were plowed 36 cm deep with conventional farm tractors and plows. The remaining plots were plowed with a 76-cm moldboard. Forage sorghum was grown on all the plots and crop yields and quality were evaluated. Experimental results indicated that sandy soils like those in the El Paso study might best benefit from manure applications of up to 672 mtons/ha. Total yields of corn and forage sorghum over the three year period indicated little advantage to deep plowing the manure. The 46-cm moldboard performed adequately and had an enormous economic advantage. Soil similar to that of Tulia could best benefit from manure applications of 224 mtons/ha or less. Both plant height and plant population were decreased with manure applications in excess of 224 mtons/ha, (Merryman-East Central).

## 2030-A3, A8, B2, B3, E2

### CROP AND HAY LAND DISPOSAL AREAS FOR LIVESTOCK WASTES

Agricultural Engineer, U.S. Department of Agriculture, Morris, Minnesota
R. A. Young
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 484-492. 6 tab, 12 ref.

Descriptors: *Crop response, *Agricultural runoff, *Erosion, Nutrients, Weed control
Identifiers: *Land disposal, *Application rates

Tests were undertaken to study the effect of surface spreading animal wastes to cropland before the plants were tall enough to preclude travel over the fields. The first year fifteen field plots were established, five on each of three crops — corn, oats and alfalfa. For each crop, two plots received twelve tons per acre of solid dairy manure, two received 0.25 inch of liquid beef cattle manure, and one was a check plot on which no manure was applied. Manure was applied within thirty days after planting or within two weeks after the first alfalfa cutting. The second year, thirteen more corn plots and ten more alfalfa plots were listed. This time the manure was applied between the corn rows, precluding contact with the corn. The same application rates were used. In addition, four of the plots that had solid manure applied between the rows were cultivated immediately after cultivation. Simulated rainfall was used to generate runoff and soil loss, The following conclusions were made: (1) Direct contact of plants with manure burned the plants; (2) Manure applications between the rows increased the yields and prevented such burning; (3) Manure applications conserved soil and water; (4) Concentration of nutrients in runoff and soil was quite high, but the total loss of nutrients was not great due to reduction of soil loss and runoff; (5) Loss of nitrogen from surface spread plots through volatilization of ammonia was high; (6) Application of animal wastes to growing crops early in the season effectively helped control weeds. (Merryman-East Central).

## 2031-A8, B2, E2

### EFFECTS OF SPRINKLER APPLICATION OF LAGOON EFFLUENT ON CORN AND GRAIN SORGHUM

Department of Agricultural Engineering, Georgia Coastal Plain Experiment Station, Tifton
C. V. Booram, T. E. Loynachan, and J. K. Koelliker
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 493-502. 10 tab, 10 ref.

Descriptors: *Sprinkler irrigation, *Effects, *Lagoons, *Effluent, Corn, Grain sorghum
Identifiers: *Land disposal, Application rates

A study was initiated in 1971 to investigate the effect of anaerobically treated swine wastes on corn and grain sorghum. In 1972, grain sorghum was omitted. Anaerobic swine wastes were applied by sprinkler irrigation with the following objectives: (1) Investigate management necessary for liquid disposal on growing corn and grain sorghum by conventional equipment; (2) Evaluate the effect of the rate and time of application on corn and grain sorghum yields; (3) Evaluate any detrimental effects on corn and grain sorghum. Application of lagoon effluent increased leaf phosphorus and nitrogen in both corn and grain sorghum. Sodium and iron contents increased in corn leaves, and manganese, copper, and zinc contents increased in grain-sorghum leaves. Nutrient concentration in the plant tissue increased but not to a level that would cause problems if the entire plant were ensiled. The effluent had no significant effect on corn yield, but it had a significantly negative effect on grain sorghum yield with decreases up to 53 bushels per acre. Increasing amounts of effluent resulted in significantly increased value of extractable phosphorus and exchangeable potassium in the surface two inches of soil. Salt levels in the soil also increased, but leaching resulted in negligible accumulation. (Merryman-East Central).

## 2032-A8, B2, C2, E2, F1

### EFFECT OF LIQUID SWINE WASTE APPLICATION ON SOIL CHEMICAL COMPOSITION

Purdue University, West Lafayette, Indiana
A. L. Sutton, D. W. Nelson, V. B. Mayrose and J. C. Nye
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 503-514. 3 fig, 5 tab, 21 ref.

Descriptors: *Liquid wastes, *Salts, *Soil chemical properties, Aerobic treatment, Nitrates, Phosphorus, Sodium, Soil profile
Identifiers: *Swine, Application rates, Anaerobic treatment, Oxidation ditch

A $2_3$x5 factorial arrangement of treatments in a randomized complete block design experiment was used to study the following treatments: effects of dietary salt content (0.2 percent, 0.5 percent), anaerobic and aerobic waste handling systems, and five application rates, (0, 45, 90, 134 mT/ha waste; inorganic fertilizer) on the recycling of swine wastes to a sandy loam and silty clay loam soil cropped to corn. It was found that: (1) No ammonium nitrogen or nitrate nitrogen accumulated in silty clay loam soil from swine waste application. (2) Nitrate nitrogen in sandy loam soil leached to lower depths after the first year of waste application but not after the second year of waste application. (3) Available phosphorus levels in both soils increased with increased waste application rates. (4) Exchangeable sodium content in both soils increased with increased waste application rates. (5) There was increased soil sodium concentration and decreased soil phosphorus concentration in the plots treated with waste from pigs fed the 0.5 percent salt diet compared to the plots treated with the waste from pigs fed the 0.2 percent salt diet. (6) Sodium accumulated through both soil profiles. (7) Application of liquid swine waste at the above rates did not adversely affect the chemical composition of the soil and did not adversely affect corn production. (Merryman-East Central).

## 2033-A5, A8, B2, B3, B4, C2, E2

### MANURE HOLDING POND SEALING STUDY

Agriculturalist, California State Water Resources Control Board
D. Baier, J. L. Meyer, and D. R, Nielsen
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 515-521. 4 fig, 3 tab.

Descriptors: *Seepage, *Nitrates, Total dissolved solids, Construction, Salts, Biochemical oxygen demand
Identifiers: *Manure, *Holding ponds, *Sealing

The purpose of this study was to determine the extent of water seepage through the bottom of waste holding ponds as a function of time following their construction and use, and concomitantly examine total dissolved solids (TDS) both in the pond and in the soil solution beneath the pond with special attention given to nitrates. Additionally, the fate of nitrates and other salts were evaluated when field-dried manure was applied as fertilizer. It was found that: (1) salt concentrations in dairy pond water increase in direct proportion to the pond's age; (2) after six months of use, the pond appeared to have self sealed; (3) anaerobic reduction of nitrate to $N_2$ gas (which then passes off to the atmosphere) and prevention of the mineralization of ammonia due to the paucity of oxygen kept nitrate content of the pond low; (4) BOD did not significantly change with depth in the ponds; (5) danger of nitrate pollution to land is reduced when such denitrified pond water is used on fields while land application of dry manures at 76 cubic meters per hectare per year was found to have great potential for groundwater pollution. (Merryman-East Central).

## 2034-A8, B2, B3, C2, E2

### SOIL MODIFICATION FOR THE DISPOSAL OF DAIRY CATTLE WASTES

Department of Soil Science and Agricultural Engineering, California University, Riverside
A. C. Chang, P. F. Pratt, K. Arei, and D, C. Baier
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 522-532. 3 fig, 11 tab, 7 ref.

Descriptors: *Dairy industry, *Soil management, *Nitrates, *Salts
Identifiers: *Waste disposal, *Liquid wastes, *Impervious membrane

A field trial was conducted to test the feasibility of installing an impervious asphalt membrane thirty inches below soil surface for the disposal of liquid and solid dairy wastes. The solid waste was applied to the land just before each of two crop plantings. Wastewater was then applied by flood irrigation throughout the growing season. Results follow. (1) The impervious layer effectively prevented downward movement of the salt-latent leaching water and reduced nitrate by denitrification. Salts were concentrated in small amounts of drainage water and pumped out of the pump. (2) The barley and sorghum crops were seriously damaged by unfavorable soil conditions created by the asphalt membrane and by improper water management. (3) The unavailability of a reliable technique for installing the membrane and the damaging effect that this technique had on the crops negates any promising use of this system, but the author does feel that utilizing a natural water-restricting layer in the soil for waste disposal should be encouraged. (Merryman-East Central),

## 2035-A6, B1, D1, D2

### POSSIBLE WAYS OF ABATING THE NUISANCE OF SMELL CAUSED BY LIVESTOCK AND POULTRY FARMS

Institute for Farm Buildings,
Wageningen, Holland
A. A. Jongebreur and M. Van Geelen
Processing and Management of Agricultural Waste, Proceedings of the 1974 Cornell Agricultural Waste Management Conference, Rochester, New York, March 25-27, 1974, p. 533-540. 3 fig, 13 ref.

Descriptors: *Odor control, *Poultry, *Livestock, *Ozone, Economics
Identifiers: *Public Nuisance Act, *Swine, *Deodorants, *Air washers

It is practically impossible to completely eliminate the generation of odorous gases from animal producing units. The Public Nuisance Act has been responsible for many owners of piggeries and poultry houses trying to reduce such odors, however. Among the methods tried are the use of deodorants, ozone applications, and air washers. Because the components of the deodorants and their possible influence on both human beings and animals are not sufficiently known, a permit under the Public Nuisance Act to operate with the use of deodorants can be refused. Ozone application has been found to reduce smells of exhaust air from piggeries and poultry houses, but not from broiler houses. Since the influence of ozone on the organ of smell is not known and since even low concentrations may be harmful, this method of odor abatement is not considered satisfactory. Installation of air washers into the ventilation systems of animal production units has proved effective, but further research is needed for establishing suitable filling materials and economical types of encasement. (Merryman-East Central).

### 2036-A6, B3, C1, D1, D2, E3, F1

### PROFIT, TOO, IN MANURE FROM PLASTIC PENS

Poultry Science Department,
Pennsylvania State University
G. O. Bressler
Broiler Industry, p. 33, 36, August, 1972. 4 fig.

Descriptors: *Farm wastes, *Poultry, *Economics, *Waste treatment, *Recycling, *Drying, Odor, Moisture content
Identifiers: *Broiler breeders

High density housing for broiler breeders is increasing and the quantity of manure which is more highly concentrated and has a greater likelihood of offensive odors, is also increasing. The two-stage manure handling system developed at Penn State solves these problems. As part of the sloping floor housing system, the two-stage manure handling system is completely automatic and it is a good economic (as well as ecological) investment because the end product has marketable value. Stage 1 of the process drys the manure in two ways and reduces the moisture content from 75 percent to 35 percent. The two drying methods are: (1) Vertically mounted fans under the sloping floors; and (2) A stirring mechanism that automatically agitates the manure several times daily. Stage 2, drying of excreta in a commercial heater-dryer, reduces the moisture content down to 10 percent. Although the two-stage drying system costs $15 per ton, the end product easily brings twice as much from garden center and industrial users. (Kehl-East Central).

### 2037-A6, B1, F2

### MANURE ODORS CAN LAND YOU IN COURT

Central Field Staff, Farm Journal
J. Russell
Farm Journal, Vol. 89, p. 19, August, 1965

Descriptors: *Odor, *Legal aspects, Urban development, Zoning
Identifiers: Livestock operations, Agreements, Licensing

Many times, when people are close to a livestock operation a clamor arises against farm odors. This can result in the closing of the livestock operation. Some suggestions to help head off trouble are given and discussed. They are: (1) Zoning. If enough farmers ask for it, a special agricultural zone which is off-limits to any other use can be established. But a warning is given to remain alert for public hearings at which "exceptions" and "variances" may be granted. (2) Licensing. In order to obtain a license for more than a specified number of head, certain housekeeping standards must be met. (3) Agreements which spell out how feeders can keep the city off their backs. Trouble can be headed off by dairymen and farmers by considering future urban developments. (Kehl-East Central).

### 2038-A11, B3, D1, E3, F5

### POULTRY WASTE FOR CATFISH

Feedstuffs, Vol. 47, No. 2, p. 20-21, January 13, 1975

Descriptors: *Catfishes, *Diets, *Performance, Proteins
Identifiers: *Poultry waste, *Air-drying

Studies showed that air dried poultry waste fed to pond-cultured catfish as a component of the diet resulted in acceptable growth and conversion efficiency. Diets fed included a basic diet containing fish meal and poultry byproduct meal as sources of animal protein; a diet containing 25 percent air-dried poultry waste and sources of animal protein and a similar diet with no source of animal protein. Better weight gains resulted from the catfish consuming diets containing air-dried poultry waste. Taste evaluation revealed no significant differences. (Cameron-East Central).

### 2039-B2, B5, C1, C2, D1, D3, E1

### DEMONSTRATION OF WASTE DISPOSAL SYSTEM

Moore Engineering, Inc., Consulting Engineers,
West Fargo, North Dakota
C. R. Moore
U.S. Environmental Protection Agency Report Number EPA-R2-73-245, May 1973, 50 p. 7 fig. 18 tab, 12 ref.

Descriptors: *Cattle, *Hogs, *Animal wastes, *Sheep, Chemical oxygen demand, Biochemical oxygen demand, Waste treatment, Settling basin, Nitrates, Groundwater, Feedlots
Identifiers: *Stockyards, *Hydrasieve, Sheyenne River, Truck washrack, Solids separation

Laboratory studies of livestock waste were conducted both before and after the construction of an enlarged settling basin, a hydrasieve at the truck washrack and a two cell waste stabilization pond. A determination of the effectiveness of these two systems and the application of them to feedlots and other livestock facilities in the area were the main objectives. The settling basin and hydrasieve were effective in removing solids and COD from the truck washrack waste. Reductions in COD, total, suspended, and settleable solids were 23.9, 14.8, 50 and 80 percent, respectively. DO increased 42.8 percent and total solids decreased 3 percent across the hydrasieve. This 3 percent consisted of straw and other floating debris which would not be removed at the stabilization pond. The effectiveness of the stabilization ponds were generally good. The $BOD_5$ of the final effluent was reduced 48.6 percent over that of the drainpipe which had drained directly into the Sheyenne River during previous years. (Moore-Moore Engineering, Inc.).

### 2040-A11, E3, F1

### PROCESSED EXCRETA POTENTIALLY NUTRITIONAL

Western Livestock Journal, Vol. 53, No. 11, p. 68, January, 1975. 2 fig.

Descriptors: *Cattle, *Feeds, *Proteins, *Recycling, Performance
Identifiers: *Excreta, *Refeeding

Whenever protein supplies such as soybean meal or urea are in short supply, protein from cattle excreta can be nutritionally beneficial in supplementing Corn Belt feedlot rations prior to the final month or two of finishing. The benefit from the protein in the excreta was seen in increased weight gains. Lower feed costs of gain is a favorable aspect of excreta-fed cattle when no charge is made for the excreta and processing of it through a silo. Health of the cattle in no way appeared to be adversely affected during 5½ months of feeding fermented excreta. Scientists say more research is needed before results obtained in experiments thus far can be recommended in cattle feeding practice. (Cameron-East Central).

### 2041-A11, B1, D1, D2

### THE MANY ASPECTS OF SANITATION IN POULTRY DISEASE CONTROL

DeKalb AgResearch, DeKalb, Illinois
D. Halvorson
Poultry Digest, Vol. 33, No. 387, p. 190-196, May 1974, 5 fig.

Descriptors: *Environmental sanitation, *Poultry, *Disinfection
Identifiers: *Disease prevention, Fumigation

Sanitation is the reduction of some organisms and the elimination of others. A discussion of a program to prevent disease outbreaks in poultry is presented. Three basic disease prevention methods are: (1) The eradication of the pathogen, (2) The reduction in numbers of pathogenic microorganisms, and (3) The opportunity to increase the resistance of the host. Sanitation should be considered in all phases of poultry breeding. The breeding stock should be selected from a clean flock and should be kept clean. An outline or program for the production of nest-clean hatch eggs should be drawn up. Dirty and cracked eggs should be separated at the breeder house and then the clean eggs should be fumigated after each gathering to kill surface bacteria before they penetrate the shell. Breed house construction plays a part in the sanitation of the house and the egg. A table comparing wire floor and litter floor houses is given. The hatchery should be clean to receive the sanitary eggs. A program of clean-up and disinfection of a house after the removal of the birds is also important. Removal of dust and droppings necessitates a washdown of the poultry house and equipment followed by disinfection. Sanitation as applied to feed is also discussed. Water sanitation depends mostly on the source and the means of cleaning and disinfecting the system. Ventilation dilutes disease organisms and plays a major role in air sanitation. (Kehl-East Central).

### 2042-A4, B2, B3, C2, E2, F1

### THE IMPACT ON DAIRY FARM ORGANIZATION OF ALTERNATIVE MANURE DISPOSAL SYSTEMS. A METHOD OF ASSESSING THE COST OF ENVIRONMENTAL REGULATION

A. Muhammad, R. L. Christensen, and G. E. Frick
Research Bulletin Number 608, University of Massachusetts Agricultural Experiment Station, Amherst, Massachusetts, May 1974. 40 p. 24 tab, 17 ref.

Descriptors: *Dairy industry, *Costs, *Waste disposal, *Regulation, Water pollution, Nutrients, Fertilizers
Identifiers: *Linear models, Land disposal, Stacking systems

The economic impact is given for controlled use of commercial fertilizers and of alternative waste disposal systems on 25 dairy farms with small, medium, and large herd sizes from the 3 geographical dairy regions of Massachusetts. Also evaluated are alternative manure disposal systems and farm resource adjustments minimizing the cost of meeting manure disposal constraints on individual dairies. Stacking and liquid pollution control systems required additional capital expenditure of 2 to 3 times and 3 to 5 times respectively, when compared to daily spreading systems. The liquid systems caused greater reductions in farm income compared to stacking systems, with the opportunity cost larger on free stall dairies than on stanchion dairies. Manure disposal may be improved by avoiding confinement systems and by acquiring additional acreage for forage production. The inclusion of plowing operations with the stacking and liquid systems yielded about twice and one-third greater cost opportunity than systems not requiring immediate plowing. On small farms, disposal in conjunction with plowing would be preferred because the added value of nutrients exceeded the combined marginal cost of labor and plowing. Results indicated a trade-off relationship between dairy farm income and enhancement of water quality. Income levels of the dairy operations could be restored to previous levels by acquiring about 50 acres of cropland and seasonal labor of 15 hours per week on 100 cow and 50 cow farms and 40 hours per week on 212 cow farms. (Battles-East Central).

### 2043-A8, B2, C2, E2

### GUIDELINES FOR LAND DISPOSAL OF FEEDLOT LAGOON WATER

Kansas State University, Cooperative Extension Service, Manhattan
W. L. Powers, R. I. Herpich, L. S. Murphy, D. A. Whitney, H. L. Mandes, and G. W. Wallingford
Cooperative Extension Service Circular C-485, Kansas State University, Manhattan, June, 1973, 7 p. 9 fig. 2 tab, 1 ref.

Descriptors: *Feedlots, *Lagoons, *Kansas, *Soils, Sodium, Potassium, Salt, Alkali
Identifiers: *Guidelines, *Land disposal, *Electrical conductivity, Application rates

This publication provides guidelines for feedlot operators on how to dispose of lagoon water on agricultural lands in order to minimize the chance of reducing the land's productivity. Lagoon water may be pumped onto soil after being diluted and only if it has a low electrical conductivity. The feedlot operator should follow these steps when disposing of lagoon water on soil: (1) Have the lagoon and diluting water analyzed. (2) Determine the soil texture on the disposal site; (3) Examine the water test results to see if the sodium plus potassium content is high enough to disperse the soil, (4) Dilute the lagoon water and pump the water onto the disposal site; (5) Find the maximum amount of undiluted lagoon water that can be added to the soil, but apply undiluted lagoon water only as a last resort; (6) Have an annual salt-alkali test performed on the soil from the disposal site; (7) Seek professional advice if the proper dilution factor is not found. (Battles-East Central).

### 2044-B2, D3, F1

### LIQUID AEROBIC COMPOSTING OF CATTLE WASTES AND EVALUATION OF BY-PRODUCTS

Chino Basin Municipal Water District,
P. O, Box 697
Cucamonga, California
F. Grant, and F. Brommenschenkel, Jr.
Environmental Protection Agency Report Number, EPA-660/2-74-034, May 1974, 50 p. 2 fig, 16 tab, 36 ref.

Descriptors: Liquid wastes, *Cattle, *Aerobic treatment, *By-products, Economics, Biological oxygen demand, Chemical oxygen demand
Identifiers: *Composting, Volatile solids, Thermophilic reactor, Mesophilic reactor, Total dissolved solids

The study was undertaken to determine the technical and economic feasibility of treating dairy waste in a liquid state by a tandem thermophilic-mesophilic aerobic stabilization process, more commonly described as liquid composting. Experimental apparatus were set up at an operating dairy and a program was organized to study the process. The study showed that a large fraction of dairy manure is relatively resistant to rapid biological degradation even at thermophilic temperatures. Antithetical requirements of sufficient oxygen for maximum biological activity and minimum air flow to preclude the need for an external heat source could not be satisfied with the particular experimental aparatus when utilizing air as the oxygen source. Improved results were obtained with an oxygen-enriched air supply which pointed out the potential advantage of a pure oxygen system. Preliminary cost estimates for a liquid composting process to serve 500 cows were developed within the context of current dairy operation economics. The estimates showed that the process is considerably more costly than current, conventional, composting operations and that the cost of the process is substantially above levels which could be maintained by dairy operations. (Grant-Chino Basin Municipal Water District).

### 2045-A6, B4, C2

### CORRELATING ODOR INTENSITY INDEX AND ODOROUS COMPONENTS IN STORED DAIRY MANURE

Department of Agricultural Engineering,
Clemson University
Clemson, South Carolina
C. L. Barth, D. T, Hill, and L. B. Polkowski
Transactions of the ASAE, Vol. 17, No. 4, p. 742-744, July-August, 1974. 6 fig, 2 tab, 18 ref.

Descriptors: *Odor, *Dairy industry, Aeration, Volatile organic acid, Hydrogen sulfide, Ammonia
Identifiers: *Odor Intensity Index, *Threshold level

Four manure storage reactor units were initially filled to design depth with tap water while manure was added to the 11.3 liter units regularly and supernatant was removed to maintain a constant volume. Three of the units were aerated in the upper 8 to 17 in. of the supernatant while one unit received no aeration. Five levels of dilution of each 20 ml sample of reactor supernatant were collected to be presented to a panel of judges. The threshold level and Odor Intensity Index (OII), was established as that dilution level at which half the panelists correctly detected the odor. It was concluded that: (1) Of the three odorants involved, OII correlated best with volatile organic acid concentration, next best with hydrogen sulfide and poorest with ammonia. (2) The best two odorant relationships with OII were expressed by volatile organic acids and $NH_3$ while inclusion of $H_2S$ did little to improve the fit of the regression function. (Battles-East Central).

### 2046-A6, B1, C2, C3, D2, D3, E2, E3

### BREAKTHROUGH IN THE FIGHT AGAINST POLLUTION

D, Braun
Farm Journal, Vol. 96, No. 12, p. 20-21, December, 1972. 3 fig.

Descriptors: *Thermophilic bacteria, *Waste treatment, *Waste disposal, *Recycling, Cattle, Costs, Odor
Identifiers: Pollution control

Two reputable companies have patented systems that use thermophilic bacteria (active at temperatures above 100 degrees) to dispose of animal wastes. De Laval Separator Co. introduced a system that digests about 95% of the manure solids in just a few days and the system takes no more space than the holding pen for a big milking parlor. The General Electric Co. is operating a pilot plant that turns manure from 100 head of feedlot cattle into high-protein material. The new systems promise to control pollution and do away with odors. Thermophilic bacteria digest some cellulose and lignin as they turn manure into carbon dioxide and water. They also kill pathogenic bacteria with the heat they generate. The remains can be stored and spread later without odor. (Cameron-East Central).

### 2047-B1, D2, E3

### CONVERSION OF MANURE TO OIL BY CATALYTIC HYDROTREATING

Pittsburgh Energy Research Center, U. S. Department of the Interior, Bureau of Mines, 4800 Forbes Avenue, Pittsburgh, Pennsylvania 15213
Y, C. Fu, E. G. Illig, and S. J. Metlin
Environmental Science and Technology, Vol. 8, No. 8, p. 737-740, August, 1974. 3 fig, 6 tab.

Descriptors: *Recycling, *Oil, *Catalysts, *Hydrogen, *Sodium bicarbonate, Feeds
Identifiers: Catalytic hydrotreating, Cobalt malybdate

Bovine manure, like coal, can be hydrogenated and liquefied at elevated temperatures and pressures in the presence of a vehicle and a cobalt malybdate catalyst. A promising method of hydrotreating organic wastes using synthesis gas and a combination of cobalt malybdate-sodium carbonate catalyst is presented in this report. The oil produced at 380°C has a low oxygen content and a high heating value. Addition of sodium carbonate to the reaction mixture, when using synthesis gas, improves oil yield, reduces oil viscosity, and reduces hydrogen consumption. Manure with moisture contents up to about 35% was evaluated and found acceptable as feed stocks. The other feature of the process is that it requires no process water. (Cartmell-East Central).

### 2048-A7, B1, B2, E2, F1

### CONVENTIONAL, CONFINEMENT OR FLUME

E. W. Manthey
Feedlot Management, Vol. 16, No. 5, p. 9-13, 41-42, 44, 47, May, 1974. 10 fig, 1 tab,

Descriptors: *Confinement pens, *Flumes, *Costs, *Performance, Agricultural runoff, Ammonia, Fertilizers, Irrigation
Identifiers: *Slotted floors, *Waste management, Flushing

An interview dealing with how conventional feedlots, slotted floor systems and flume floor confinement systems compare is presented. The savings of the slotted floors over the conventional feedlot includes: less mileage on the feed truck, fewer cleaning costs, no need for sprinkling, and reduced labor. Also, the waste from the slotted floor system can be pumped inexpensively and used as a fertilizer. The flume floor system has to be hydraulically flushed twice a day. Some other disadvantages of the flume floor include: slipping of the cattle and cowboys, dirty cattle, and manure buildup. The slotted floor system has none of these problems but it and the flume floor both have the problem of ammonia. The ammonia in the slotted floor system can be controlled with a chemical, but there is no way to control it in the flume system. The cost of the flume system is lower than the slotted system, but the slotted system is preferred by the builder interviewed. (Cartmell-East Central).

### 2049-B3,B5,C2,C3,D1,D3,E3

### MANURE-ROUGHAGE SILAGE FOR RUMINANTS

Poultry Digest, Vol. 34, No. 395, p. 27-28, January, 1975

Descriptors: *Silage, *Ruminants, *Nutrients, *Feeds, Nitrogen, Proteins, Fermentation
Identifiers: *Refeeding, *Manure, *Roughage

A manure dryer is not a logical investment for a small operator because of its cost. A silo used to store poultry manure mixed with dry roughage is likely to be an economically sound choice because ruminant animals can utilize the nonprotein nitrogen in poultry manure and dry roughage is usually available. There are many advantages to mixing instead of drying. First, the energy and labor usually needed in drying manure is not required. Second, the moisture in the manure raises the moisture content of the silage mixture to a desirable 50-60 percent level. The fermentation process produces a pathogen free product and is equal in feed value to alfalfa in protein and total digestible nutrients, The main disadvantage is that poultry manure loses nitrogen if it is compacted when putrefaction starts. Protein is also lost when this occurs. This can be prevented by stirring or blowing air over it or by mixing in roughage on a weekly basis and putting it in a silo. Wilted hay as roughage could be used in the spring and summer while stalks and straw could be available in the fall and winter. Mixing would take place as it is fed through a blower into the silo. Ration comparisons are discussed. The value of silage as a feedstuff is given. The FDA has not approved the use of poultry manure for feed but it has encouraged testing and further experiments. (Kehl-East Central).

### 2050-D2, E3

### METHANE PRODUCTION FROM SWINE WASTE WITH SOLAR REACTOR

Department of Biological and Agricultural Engineering, North Carolina State University, Raleigh
R. Parker, F. Humenik, R. Holmes, and M. Overcash
Presented at 1974 Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-3033, 8 p., 2 fig, 6 ref.

Descriptors: *Methane, *Feasibility studies, Energy
Identifiers: *Swine, *Mesophilic solar reactors, *Thermophilic reactors, *Methane digestion

Methane digestors may help solve the problems of waste treatment and energy conservation by utilizing animal wastes that provide energy rich nitrogenous and carbonaceous compounds. The preliminary results for the operation of a mesophilic solar reactor without supplemental heating and a thermophilic unit heated from 130 F. to 155 F. are presented. The model methane reactors are treated as possible preliminary treatment devices for energy conservation before the discharge of reactor fluids to a lagoon with terminal land application of excess liquid. Methane gas as fuel is not as efficient as other more widely used sources but may have to be considered in the future because of its long range availability and production rates. (Kehl-East Central)..

## 2051-A2,A5,A11,B1,B2,B3,B4

### BROAD BASIN TERRACES FOR SLOPING CATTLE FEEDLOTS

Agricultural Engineer, U. S. Department of Agriculture, Lincoln, Nebraska
N. P. Swanson, J. C. Lorimor, L. N. Mielke
Transactions of the ASAE, Vol. 16, No. 4, p. 746-749, July-August, 1973

Descriptors: *Terraces, *Feedlots, *Design, *Waste storage, *Waste disposal, *Agricultural runoff, Erosion control, Solid wastes, Slopes, Effluent, Nitrates, Cattle
Identifiers: *Broad basin terraces

Broad basin terraces in Nebraska cattle feedlots were developed to control erosion, restrict scouring and movement of solids by runoff, provide storage for runoff, and permit retention of solids in the feedlot for removal. A single basin was constructed in July, 1969, near Omaha with a 15 percent slope, a 448-ft overall slope length and a basin storage capacity adequate for a year's runoff. Experience revealed that 340 ft is the maximum slope length recommended for a 15 percent slope. A series of three terraces was constructed on a feedlot site near Springfield, Nebraska with an average slope of 7 percent. Basins were installed with slope lengths averaging 100, 150. and 170 ft. from the top to the bottom of the terrace where underground pipelines delivered the effluent by gravity to a holding pond. The longer and steeper slope length above the lower basin was too long; solids collection during 2 years averaged 0.6 cu. yd. per animal per yr. compared to 0.5 and 1.1 for the middle and highest basins. The basin bottom should be flat with a minimum width of 10 to 12 ft. to aid solids removal with a tractor mounted front-end loader; the bottom area of the basin should be large enough to prevent accumulated solids depths in excess of 6 to 8 inches in the intervals between cleanings. Design depth for temporary water storage in a basin should not exceed a safe depth for the size animals stocked in the feedlot. A manure cover over the feedlot will provide protection from nitrate pollution of groundwater and water erosion. (Battles-East Central).

## 2052-B1

### CONSTANT RATE DRYING OF CHICKEN EXCRETA

Agricultural Engineering Department, Idaho University, Moscow
G. D. Wells, M. L. Esmay, and F. W. Bakker-Arkema
Presented at 66th Annual Meeting, American Society of Agricultural Engineers, Kentucky University, Lexington, June 17-20, 1973, Paper No. 73-400, 17 p. 4 fig, 2 tab, 7 ref.

Descriptors: *Poultry, *Drying
Identifiers: *Excreta, *Drying rates

The purpose of this research was to determine quantitive drying rates for chicken excreta under moderate environmental conditions found in poultry houses. The following two conclusions were supported by this research dealing with drying of chicken excreta in thin layers of less than 1 cm (½ inch). 1. The initial drying rate of fresh chicken excreta is constant. Falling rate drying periods follow the constant rate period. 2. The constant rate is a function of the boundary layer thickness and boundary layer concentration gradients with the surface at saturated conditions. (Cartmell-East Central).

## 2053-A11,B2,C2,D2,D3,E3

### SWINE WASTE AS NUTRIENT SOURCE FOR FINISHING PIGS

Department of Animal Husbandry,
Michigan State University,
East Lansing
D. E. Orr
Research Report 232, Report of Swine Research 1973, Agricultural Experiment Station, Michigan State University, East Lansing, September, 1973, p. 81-87. 1 fig, 12 tab,

Descriptors: *Feeds, *Nutrients, *Performance, Amino acids, Digestion
Identifiers: *Swine, *Oxidation ditch liquor, *Dried swine feces

With an increase in swine production, special consideration has been demanded by the problems associated with waste handling and odor control. An approach to these problems has been the operation of an oxidation ditch containing a paddle wheel which incorporates oxygen into liquid swine wastes for the purpose of promoting aerobic microbial activity and reducing odors. A study to evaluate the oxidation ditch liquor (ODL) as a source of nutrients in swine finisher diets was designed. Tables showing the nutrient composition, amino acid composition, digestion trial diets and their results for dried swine feces (DSF) and ODL diets were given. The study showed that finishing pigs will consume normal intake levels of corn-soy diets containing up to 22% DSF. When DSF is incorporated into corn-soy diets to replace a portion of the soybean meal, the rate and efficiency of gain are depressed. Performance from these diets can probably be improved by the addition of supplemental energy to diets containing DSF. The incorporation of DSF into a finisher diet resulted in a depression of apparent digestibility of dry matter, protein and energy. Pigs receiving ODL in their diet showed no improvement in performance. ODL diets resulted in lower apparent digestibility coefficients for dry matter, protein and energy in digestion trials. (Kehl-East Central).

## 2054-A6, A8, B1, C1, C2, D1, D2, E3, F1

### PROFITABLE USE OF POULTRY MANURE

The Pennsylvania State University,
College of Agriculture, Extension Service,
University Park, Pennsylvania
W. W. Hinish and H. C. Jordan
Special Circular 146, The Pennsylvania State University, College of Agriculture, Extension Service, University Park, 4 p, 1 fig, 3 tab.

Descriptors: *Waste treatment, *Waste disposal, *Poultry, *Nutrients, Moisture content, Marketing, Litter
Identifiers: Pollution

A discussion of poultry manure, its plant nutrient content, moisture content, weight per bushel and its economic value is given. Within the first year after application, essentially all of the plant nutrients in poultry manure are available to plants. However, up to two thirds of the nitrogen can be easily lost. Three ways in which nitrogen losses through fermentation can be reduced are by use of: (1) ventilated, well-insulated houses; (2) litter materials which will rapidly dry the manure; and, (3) superphosphate to reduce gaseous loss of nitrogen as ammonia. Additional information concerning the above methods is given. A table showing application rates of poultry manure for various crops is given. Marketing of the poultry manure is examined in relationship to season, common wholesale outlets, pellet size, the cost of pelleting manure, general demand for bagged manure and pollution. Two common problems of manure, burning of plants and odor, are discussed. Five ways to insure increased retail and wholesale business were suggested. They are: (1) Dry manure as it is produced; (2) Have nitrogen, phosphorus and potassium tests run on samples from manure you are planning to sell; (3) Advise the buyer of definite application rates; (4) Advise the buyer on methods of application; and (5) Tell the customer that manure should be stored in a cool, dry place. (Kehl-East Central).

## 2055-B2, C2, D2, E3, F1

### THEY PLAN TO EXPORT LIQUID MANURE TO THE ARABS

Hoard's Dairyman, Vol. 120, No. 3, p. 188-189, February 10, 1975

Descriptors: *Liquid wastes, *Export, Fertilizers, Nitrogen, Phosphorus, Potassium
Identifiers: *Deodorizer, *Persian Gulf Countries

Liquid manure may become a new export because of the fertilizer shortage and the food crisis. If this comes to pass, it will be because of the development five years ago of a compound that inhibits the growth of odor-producing bacteria and prevents swelling. The compound is "Nature's Own Deodorizer" and has been sold to dairymen for treatment of their liquid manure. Handling rights for the deodorant are held by Richard J. Briggs, Woodbury, Tennessee, who granted franchises to 40 dairymen from 40 states. The stabilized waste was shown by a Louisiana export broker to Mideast customers who saw the potential of utilizing returning tankers for importing organic matter and fertilizer nutrients for their unproductive, sandy soils. Six small Persian Gulf countries are included. Working through the dairymen to whom he sold franchises, Briggs is contracting for liquid manure to export. The contract would require the dairyman to supply an agreed-upon amount of manure each month and the manure must contain at least 0.2% each of nitrogen, phosphorus, and potassium. University tests have shown that meeting these requirements, particularly the phosphorus level, may be difficult. Contract requirements and the responsibilities of both the supplier and buyer are discussed. The liquid manure will cost more than the current fertilizer prices. However, the organic matter in the liquid manure has some additional value. (Kehl-East Central).

## 2056-B2,B3,C2,D1,E2,E3

### MILK PLUS MANURE — HIGHER DAIRY PROFITS

J. Hudson
Progressive Farmer, Vol. 90, No. 2, p. 90-91, February, 1975. 1 fig.

Descriptors: *Separation techniques, *Dairy industry, *Liquid wastes, *Solid wastes, *Feeds, *Nutrients, *Fertilizers, *Peat, Lagoons
Identifiers: Bedding, Shelf life, Preservatives

Solid wastes from dairy livestock are being used for commercial fertilizers. Weathers Farms, Inc., Bowman, South Carolina, have developed a profitable system for collecting wastes, separating the liquid wastes from the solid wastes and storing the solid wastes. This simple system flushes any wastes in the alley into a holding tank. The liquid manure is pumped to a separator where the liquid waste is extracted leaving a moist manure. A conveyor belt carries the moist manure to a large concrete slab where it is either picked up by a peat company or used by Weathers Farms as bedding in their free stalls. The liquid waste is transported to either a lagoon or an irrigation system. North Carolina State University researchers have determined that these liquid wastes contain 80 percent of the nitrogen, some phosphorus and all the potassium that was in the solid waste; therefore, it is valuable as a fertilizer. Dr. William L. Johnson, assistant professor of animal science at North Carolina State University, mixes solid manure with corn silage and feeds this to steers and heifers with good results. The mixture, he states, is a good fiber source. Dr. Johnson discovered that screened manure will ferment if left in the sun for several days and will be rejected by livestock under these conditions. Dr. Johnson and associates are working on a special preservative to increase the shelf life of the manure. Advice on construction of such systems is given. (Kehl-East Central).

### 2057-B3, D1, D3, E3, F2

### ANTIPOLLUTION LAWS FORCE LIVESTOCK MEN TO DEVISE WAYS TO COLLECT, USE MANURE

Staff Report of The Wall Street Journal
R. E. Winter
The Wall Street Journal, Vol. 53, No. 44, p 30, March 5, 1974

Descriptors: *Legal aspects, *Recycling, *Fertilizers, *Methane, Dehydration
Identifiers: *Manure, *Refeeding, Pollution

Officials at Ohio Feed Lot Inc. have developed an enclosed system that converts cattle manure into garden fertilizer. About 16,000 head of beef cattle housed in eight metal barns are placed in pens bedded with free wastes obtained from wood-products plants. Every two or three weeks tractor-mounted loaders clean out the pens and transport the mixture of waste and wood-products to another building where a system of fans and ducts blows air through the material, assisting bacteria in breaking it down. Later the by-product is packaged and sold in 50-pound bags as garden fertilizer. Other corporations have solved pollution problems by moving away from the cities, using methane from manure for energy, and dehydrating manure to make feed. (Battles-East Central).

### 2058-A11, B3, E3, F1

### POULTRY WASTES STUDIED FOR USE IN LIVESTOCK FEED

Journal of the American Veterinary Medical Association, Vol. 163, No. 3, p. 214, August 1, 1973

Descriptors: *Feeds, *Livestock, *Performance, *Costs, *Safety, Proteins, Nutrients
Identifiers: *Refeeding, *Dehydrated poultry manure

This article discusses the production of a crude protein supplement made from dehydrated poultry manure which costs less than conventional supplements. More research is needed to ensure the safety of this kind of feed before it can be recommended for dairy and beef cattle, sheep, and goats. Cows using this feed ate less silage and consequently produced less milk than did cows on a conventional diet. However, the savings from the cheaper dehydrated poultry manure would more than compensate for the income lost from lower milk production. Each 100 lb. of concentrate contains 32 lb. of dehydrated poultry manure and 68 lb, of cornmeal. The mixture is then made into pellets. (Solid Waste Information Retrieval System).

### 2059-B3, D2, E3

### RECYCLING OF ORGANIC WASTES WITH PROCESSING SYSTEM THAT PRECISELY CONTROLS HEAT AND FLOW

Industrial Heating, Vol, 39, No. 10, p. 1924-1929, October, 1972. 6 fig.
Descriptors: *Recycling, *Organic wastes, *Equipment, *Feeds, *Fertilizers, Protein

This article discusses a Vero Beach, Florida, company which has developed a machine that can convert most types of organic waste material into useful feeds and fertilizers. This new type of heating unit incorporates Aeroflash pollution control systems. Application has been made for several patents on the machine and process. Aeroflash will process virtually any type of organic waste, including fish, crab, shrimp, and chicken wastes, manure and water weeds, in 6 to 8 sec. Bacteria are eliminated, but a high protein content is retained. The result is a finished product with very little odor and a shelf life of years. The heart of the machine is a control system that maintains the necessary heat-flow relationship. (Solid Waste Information Retrieval System).

### 2060-A2, A8, B1, F6

### MASS TRANSFER FROM A PACKED BED TO A WELL STIRRED SOLUTION AND THE MEASUREMENT OF THE EFFECTIVE PSEUDO-DIFFUSIVITY OF COD IN FEEDLOT RUNOFF THROUGH A POROUS STRATUM

S. K. Choi
MS Thesis, Department of Chemical Engineering, Kansas State University, 1969, 136 p. 27 fig, 11 tab, 24 ref,

Descriptors: *Feedlots, *Agricultural runoff, *Chemical oxygen demand, *Water pollution
Identifiers: Pseudo-diffusivity, Rate of transport, Porous stratum

The purpose of this research was to investigate the rate of transport of COD through a porous stratum saturated by water such as the soil manure surface in a feedlot. The secondary purpose was to determine this diffusion coefficient experimentally. The average value of the effective pseudo-diffusivity of COD was found to be approximately 5.02 x 10$-_{6}$ cm$_{2}$/sec at a tempature of 25+/—2 degrees C. This corresponds to the pseudo-molecular diffusivity of COD in water of 7.10 x 10$-_{6}$ cm$_{2}$/sec. Since the effective pseudo-diffusivity of COD through the porous stratum saturated by water is small, organic matter which diffuses from the earth underneath the feedlot to the surface of the lot probably does not contribute appreciably to the pollution due to the feedlot runoff. As far as COD is concerned, the main contribution to the pollution due to the feedlot runoff is the manure suspension moving along with the runoff water. (Cartmell-East Central).

### 2061-A2, B2, B3, C1, D3

### BIOLOGICAL TREATMENT OF FEEDLOT RUNOFF

Department of Civil Engineering,
Nebraska University, Lincoln
M. V. O'Neal
MS Thesis, Department of Civil Engineering, Nebraska University, Lincoln, September, 1973, 52 p. 8 fig, 10 tab, 44 ref.

Descriptors: *Biological treatment, *Agricultural runoff, *Feedlots, Water quality, Cattle, Nitrates, Waste water treatment, Activated sludge, Nebraska, Flocculation, Pilot plants
Identifiers: Clarifiers

The purpose of this study was to operate and evaluate the performance of a completely mixed activated sludge unit system. Performance was to be evaluated by comparison to parameters established in the laboratory studies and by ease of operation and maintenance under field conditions. Conclusions reached were: (1) Organic loading of 0.2 gm COD/gm mixed liquor suspended solids (MLSS) or less will minimize waste strength reduction. (2) The clarifier can effectively retain solids in the system. Effectiveness of sedimentation depends upon maintenance of a flocculant sludge and MLSS concentrations not exceeding 6,000 mg/1, (3) The unit is generally maintenance free and easy to operate. Periodic measurements of settled volume provide adequate control of MLSS. (4) Foaming can become quite severe and affect the system by removing solids. Thus, laboratory studies have concluded that the runoff is amenable to aerobic treatment and a field unit was designed applying the results of these studies in order to evaluate the success of such a system in pilot scale operation. The success and subsequent application of this system will depend on the economics involved and the degree of treatment attainable. (O'Neal-Nebraska University).

### 2062-A4,A5,A6,B2,B4,E2

### MANAGEMENT OF DAIRY CATTLE WASTES BY THE DEEP AERATED LAGOON AND IRRIGATION ONTO SOILS AND PLANTS

Department of Agricultural Engineering,
Purdue University, Lafayette, Indiana
A. C. Dale, J. L. Halderson, J. R. Ogilvie, M. P. Douglas, A. C. Chang, and J. A. Lindley
Progress Report, Department of Agricultural Engineering, Purdue University, Lafayette, Indiana, 1971, 10 p, 5 fig, 5 ref.

Descriptors: *Dairy industry, *Aerated lagoons, *Analysis, Design, Irrigation, Nutrients
Identifiers: *Waste management

After preliminary field testing indicated the feasibility of an aerated lagoon and sprinkler irrigation system for management of dairy cattle manure, a full scale system has been installed at the Purdue Dairy Farm. Design criteria and operational characteristics are reported. The system is convenient and relatively odor free, does not involve a large amount of labor, is economically feasible, provides a place for storage during the winter months, conserves nutrients in the wastes, and minimizes pollution of surface and subsurface waters. (McQuitty, Barber-University of Alberta).

### 2063-B3, B5, D2, E3

### COMBUSTION DISPOSAL OF MANURE WASTES AND UTILIZATION OF THE RESIDUE

Tuscaloosa Metallurgy Research Laboratory,
Tuscaloosa, Georgia
E. G. Davis, I. L. Feld, and J. H. Brown
U. S. Bureau of Mines Solid Waste Research Program Technical Progress Report — 46, January, 1972. 1 fig, 5 tab.

Descriptors: *Burning, *Waste disposal, *Fertilizers, Potassium, Phosphorus
Identifiers: *Combustion, Manure, Rotary kiln

Agricultural manure wastes were combusted in a fluid-bed reactor or a small rotary kiln as a method for disposal of this waste material. As much as 90 percent weight reduction and 85 percent volume reduction was obtained by burning the manures. Dry manure burning in the fluid-bed reactor was self-sustaining, whereas wet manure was both dried and burned in the heated rotary kiln. Heat balance estimations indicate that preheating would be required to dry the wet manure prior to burning in the fluid-bed reactor. However, the estimation indicated that no extra heat was needed in the process if the wet manure was predried with exhausted combustion gases before being fed to the fluid bed, The burned residues were pelletized and found suitable for use both as a potassium and phosphorus fertilizer and as a lime soil conditioner. (Davis, Feld, and Brown-Tuscaloosa Metallurgy Research Laboratory).

### 2064-A8, C2, E2

### CORN SILAGE YIELD AND SOIL CHEMICAL PROPERTIES AS AFFECTED BY CATTLE FEEDLOT MANURE

USDA Southwestern Great Plains Research Center, Bushland, Texas
A. C. Mathers, and B. A. Stewart
Journal of Environmental Quality, Vol. 3, No. 2, April-June, 1974, p. 143-147. 6 fig, 7 tab, 15 ref.

Descriptors: *Soils, *Chemical properties, *Feedlots, *Cattle, Nitrogen, Organic matter, Conductance, Phosphorus
Identifiers: *Land disposal, *Application rates, *Yields

The objectives of this research were to determine the effects of various rates of manure on corn silage yields and to measure chemical residues remaining in the soil. The results showed that 224 metric tons/ha was applied, the nitrate content of the forage exceeded the maximum safe level. Nitrate accumulated in the soil with increasing rates of manure additions. Total nitrogen in the surface 30 cm of soil was markedly increased as a result of manure additions. However, there was only a small increase in the 30 to 60-cm depth, and no increase in the 60- to 90-cm depth. Sodium biocarbonate extractable phosphorus increased as the amounts of manure applied were increased. Extractable phosphorus was not increased below the plow layer indicating that measurable amounts of organic phosphates were not leached through the soil. Manure increased organic matter contents in the surface 15 cm of soil, To avoid salt damage to crops and excess nitrates in forage and soil, manure applications should not supply large excesses of nitrogen. (Cartmell-East Central).

## 2065-A11,B2,B3,D1,E2,E3,F1

### IDAHO FEEDER ENDS MANURE WORRY: ADOPTS TOTAL RECYCLING SYSTEMS

Beef Editor
P. D. Andre
Beef, Vol. 11, No. 4, p. 8, 10-11, December, 1974, 8 fig.

Descriptors: *Idaho, *Recycling, *Fertilizers, *Sprinkler irrigation, *Costs, *Performance, Liquid wastes, Solid wastes, Confinement pens, Separation tecniques, Ammonia
Identifiers: *Waste management, *Refeeding

A confinement building with a waste recycling system is discussed. The building is 104 feet wide and slightly over 400 feet long and has a capacity of 2,200 based on 20 square feet per animal. Two rows of 45-feet wide pens extend the length of the building and are separated by feed bunks and the feed alley. In this system, the waste is scraped from pits and flows to a holding pit 40 yds from the building. The wastes are then agitated and pumped to a separation unit. The solids are composted and incorporated into a growing ration. The liquid portion is pumped through a sprinkler system to fertilize a nearby field. It was noted that weather and frequency of scraping were significant in ammonia release. There was no difference in animal performance when using this system as compared to conventional systems and there were fewer health problems. Under normal operation, one man can handle the cattle and the recycling system. Addition of the recycling unit added about 25 percent to the total cost of the system. (Cartmell-East Central).

## 2066-A6,B2,B4,D3,E2,F1

### HOW IRRIGATION CAN BE USED TO HANDLE MANURE

R. E. Phillips and M. R. Peterson
Hoard's Dairyman, Vol. 119, No. 15, p. 902, August 10, 1974. 1 fig, 1 tab.

Descriptors: *Irrigation, *Waste disposal, *Costs, *Dairy industry, *Liquid wastes, *Sprinkler irrigation, *Surface irrigation, *Missouri, Lagoons, Odor, Labor, Agricultural runoff

Several Missouri dairymen are using irrigation systems to solve manure handling problems and to lower the chance of pollution. In Missouri, anaerobic lagoons are recommended for storage of liquid manure for irrigation systems. These systems are relatively economical to construct, can be mixed to handle outside yard runoff, are able to store milking parlor and milk room wastes, allow settling out of stones and other debris, and permit some decomposition of solid materials which lowers operational problems with sprinkler nozzles. A surface or sprinkled irrigation system should be chosen that is well-adapted to the topography, soil, and crop grown on the soil-plant filter. Surface irrigation systems are lower in cost, but need more labor and require flatter topography than sprinklers. Problems of irrigation disposal units are: (1) pump inlet screens clog with solids that accumulate in the storage lagoon, (2) liquid manure is hard on equipment, and (3) there is some odor. Cartmell-East Central).

## 2067-A11, B3, C2, E3, F1

### DRIED POULTRY MANURE UTILIZATION

Dawe's Laboratories Inc., Chicago Heights, Illinois
W. K. Warden
Poultry Digest, Vol. 32, No. 378, p. 344-345, August, 1973. 1 tab.

Descriptors: *Recycling, *Poultry, *Management, *Water pollution, Waste disposal
Identifiers: *Dried poultry manure, *Refeeding, *Utilization, *Nutrient value, Energy value, Waste handling

Significant efforts have been made to try to solve the enormous problems created by manure accumulation caused by raising livestock or poultry in large numbers in confinement. Reports are given on a study aimed at one facet of this problem, recycling poultry manure through laying hens — its nutrient value, limitations and economic worth. Previous studies showed that up to 40 percent dried poultry manure could be fed to laying hens with no adverse effect on production and up to 10 percent with no depression in feed conversion. The metabolizable energy value, the chief limiting factor controlling the use of poultry manure as a recycled nutrient through birds, has been determined to be 300 kilocalories per pound of air dry feed. The outlook for using DPM recycled in feeds from 20 to 25 percent of poultry and ruminant appears to offer some promise of helping to resolve the water pollution problem, but additional outlets for use will have to be found to conquer the problem. (Cameron-East Central).

## 2068-A4, B4, C3

### EFFECT OF A LIVESTOCK WINTERING OPERATION ON A WESTERN MOUNTAIN STREAM

Department of Agricultural Engineering,
Montana State University, Bozeman
C. M. Milne
Presented at 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4058, 17 p. 2 fig, 9 tab,

Descriptors: *Streams, *Water pollution, *Bacteria, *Sampling, *Analysis, Agricultural runoff, Livestock, Chemical properties
Identifiers: *Confinement wintering operations, *Ion-specific electrode

A four year project was begun during the winter of 1970-71 to evaluate the impact of livestock confinement wintering operations on the quality of waters adjacent to such operations. The approach taken was to periodically sample stream flow at several points near a wintering operation for constituents which might indicate animal activity. Five stations were established for water sampling and quality measurement. Experimental procedure varied during the course of the project. In the first two years the basic analysis methods was the ion-specific electrode. During the third and fourth years of the project, emphasis was on laboratory bacteriological and chemical analysis. Study of the chemical data revealed that (1) the values obtained were basically calcium-magnesium-bicarbonate water, (2) chlorides showed increases in concentration, and (3) nitrogen and phosphorus-related nutrients were very low. Study of the bacteriological data showed that (1) where a large amount of dispersed animal activity occurred, but was fairly dispersed, little effect on the stream was noted, (2) where the greatest amount of concentrated livestock activity occurred and it was concentrated, bacterial infection increased, and (3) where little activity occurred, bacteria counts were significantly reduced by dilution or drying off. (Cameron-East Central).

## 2069-A11, B2, D3

### WINTER OPERATION OF A MODIFIED, OPEN-FRONT FINISHING HOUSE FOR SWINE

Air Quality Engineer,
Kansas State Department of Health
D. D. Snethen, C. K. Spillman, and R. H. Hines
Transactions of the ASAE, Vol, 17, No. 2, p. 364-365, March-April, 1974. 1 fig, 2 tab, 8 ref.

Descriptors: *Winter, *Design, Environment, Temperature, Performance, Radiant heat
Identifiers: *Swine, *Confinement buildings, *Oxidation ditch

Experiments were conducted at the growing and finishing unit at Kansas State University Swine Research facility to evaluate the effectiveness of modifications for improving winter performance of swine in an enclosed building and to characterize the thermal environment of that building. As originally constructed, the building was to be operated with an open front the year-round, but during the first winter of operation, freezing impaired operation of the oxidation ditch. The following fall the building was modified from an open front to a closed front and equipment was installed to record thermal data and animal performance during the three winters from 1968-1971. Conclusions revealed that in winter climates similar to that of Northern Kansas, swine performance will be improved by enclosing the facility and providing supplementary radiant heat. The floor and inside dry-bulb temperatures in the modified building will be nearly equal thus allowing oxidation pit operation during the winter, and possibly ventilation rate for moisture control can be reduced. (Battles-East Central).

## 2070-A6, A8, C2, C3, E2

### USE OF ANIMAL WASTES AS A SOIL AMENDMENT

Agricultural Research Service,
U. S. Department of Agriculture,
Lincoln, Nebraska
T. M. McCalla
Journal of Soil and Water Conservation, Vol. 29, No. 5, p. 213-216, September-October, 1974. 3 fig, 3 tab, 22 ref.

Descriptors: *Animal wastes, *Fertilizers, *Cattle, *Nutrients, *Crops
Identifiers: *Swine, Yields

Beef and swine manure has become a resource, Rising fertilizer costs have made manure a desirable commodity due to its nutrient value. Manure contains the major fertilizer elements—nitrogen, phosphorus, potassium, and sulfur, as well as many trace elements. Application of manure to soil may improve fertility and soil structure but problems do exist — transportation costs, salt accumulation, nitrate pollution, unpleasant odors, metal toxicities, pathogen hazards, and application at rates exceeding crop requirements. These problems can be reduced or eliminated with proper management. (Battles-East Central).

## 2071-A11, A12, E2, F2

### DUNG HO: FDA SETS REGS ON RECYCLED FEED

Western Livestock Journal, Vol. 53, No. 20, p. 20, February 25, 1975.

Descriptors: *Regulation, *Recycling, *Animal wastes, *Feeds, *Antibiotics

Identifiers: *Refeeding, DES, Sulfa drugs

According to FDA official, Dr. F. E. Sterner, proposed government regulations for reprocessed grain (recycled animal waste) are coming. Dr. Sterner stated that he believes regulations will require approval of both a facility and process for manure recycling. Sterner also stated that he expects FDA to propose regulations on antibiotics and sulfa drugs. He suggested that good manufacturing regulations for medicated feeds will be announced soon. Modification of DES Feeding regulations are not expected. (Battles-East Central).

## 2072-D2, E3

### PYROLYTIC CONVERSION OF AGRICULTURAL WASTES TO FUELS

Engineering Experiment Station,
Georgia Institute of Technology,
Atlanta
J. A. Knight
Presented at the 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-5017, 25 p. 18 fig, 4 tab, 3 ref.

Descriptors: *Fuels, *Energy, *Design, Economics, Georgia, Costs, Oil, Gases
Identifiers: *Pyrolysis process, *Agricultural wastes, Cotton gin wastes, Wood wastes, Char

Agricultural wastes represent a potential source of energy, and the utilization of these wastes as energy sources would be of tremendous benefit to the agricultural interests of this country. The steady-flow, low temperature pyrolysis process developed at the Georgia Tech Engineering Experiment Station is capable of converting these wastes into clean burning fuels. The process has been developed from bench scale to a large scale demonstration facility capable of converting feed rates of 50 dry tons/day. This EES pyrolytic process offers a proven process at the commercial prototype stage for the utilization of agricultural wastes and lignocellulosic materials as energy sources. (Cameron-East Central).

## 2073-B3, C1, D1, F6

### DRYING PARAMETERS OF FORMED POULTRY EXCRETA

Canning Machinery Division,
FMC Corporation,
Hoopeston, Illinois
T. M. Midden, I. J. Ross, and H. E. Hamilton
Presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No, 72-451, 21 p. 9 fig, 2 tab, 5 ref.

Descriptors: *Drying, *Poultry, *Temperature, Air, Equations
Identifiers: *Excreta, *Cylinders, *Crusting

A study was done of the drying characteristics of formed poultry excreta. Fully exposed drying equations were used to describe the drying of manure. A series of tests were conducted to predict the constants involved in using these equations. Fresh poultry manure was formed into long cylinders and air dried at temperatures in the range of 100 to 950 degrees F. The thin layer drying characteristics were determined in the temperature range of 100 to 220 degrees F and the crusting characteristics were determined at the higher temperatures. Some conclusions based on the analysis of the data and the results were: (1) The drying constant k is a function of the diameter of the cylinders, (2) It is possible to form a stable manure cylinder by crusting with high temperature drying air, (3) Pellet crust is a function of both air temperature and time of exposure of air, and (4) The effect of temperature on the value of the thin layer drying constant for a particular diameter cylinder can be explained by an Arrhenius type equation of the form: $\ln k = a - b/T$. (Cameron-East Central).

## 2074-A11,D1,D3,E3,F1,F5

### RECOVERING PROTEIN FROM ANIMAL WASTE

Agricultural Engineering Department,
Purdue University,
West Lafeyette, Indiana
J. C. Nye, A. C. Dale, T. W. Perry, R. B. Harrington, and E. J. Kirsch
Presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-955, 18 p. 3 fig, 7 tab, 22 ref.

Descriptors: *Proteins, *Animal wastes, *Cattle, *Feeds, *Treatment, Separation techniques, Costs, Design, Recycling, Amino acids, Chemical oxygen demand, Biochemical oxygen demand
Identifiers: *Microbial food, *Batch culture, Procedures, Rats

This study evaluated the feasibility of growing microorganisms on manure as a source of protein for animal feed. The microbial protein product produced from dairy cattle waste was found to be a chemically adequate protein supplement as measured by the amino acid analysis. This biomass produce was harvested and fed to laboratory rats as 18 percent of their diet with no dilatory effect. The inability of rats to use this product as their only protein supplement indicated that more work is required to refine the process. The waste treatment-food synthesis system proposed is an economically feasible alternative for livestock operations. (Cameron-East Central).

## 2075-D2,E3,F1

### FUEL FROM LIVESTOCK WASTES: AN ECONOMIC ANALYSIS

Extension Agricultural Engineer,
California University, Riverside
W. C. Fairbank
Agricultural Engineering, Vol. 55, No. 9, p. 20-23, September, 1974. 5 fig, 1 tab.

Descriptors: *Fuels, *Organic wastes, *Economics, *Costs, *Gases, Livestock, Anaerobic digestion, Methane, Municipal wastes
Identifiers: *Liquefication, *Hydrolysis

Environmentalists loudly proclaim that farmers could solve their energy problems if they would power their machines with bio-gas from organic waste. A multistage high-pressure pump with intercooling and a storage-transportation system would be necessary for methane liquefication to produce dung gas. The anaerobic dissociation of dry manure with heat produces a gas, a pyrolyzate, and a highly mineralized char. The process offers the stimulating possibility of producing a fuel gas, and at the same time, reducing the tonnage of solid waste going to dumps. Synthesis gas, hydrogasification and dung oil are thermo-chemical processes for dissociating carbon, hydrogen, nitrogen, and oxygen compounds and then recombining the constituents into desired molecules. They all start with a carbonaceous feedstock and yield a stable product quantified in energy units. Several great cities of the world are experimenting with heat recovery processes municipal incinerators. The margin of profit on these energy recovery processes is so slight, the economy of scale so great, the complexity of the processes and facilities so real, that only municipal or corporate industry is likely to amass the capital and technical resources needed. (Cartmell-East Central).

## 2076-A4,A5,A7,A13,B1

### BEEF FEEDLOTS — A POLLUTION PROBLEM?

ARS-USDA, AERD, Livestock Engineering and Farms Structures, Nebraska University,
Lincoln.
C. B. Gilbertson
Proceedings of Agriculture and Pollution Seminar, University of Arizona, Tucson, February 19, 1971, EES Series Report No. 35, p. 18-29, 5 tab, 19 ref.

Descriptors: *Feedlots, *Management, *Water pollution, *Air pollution, *Waste disposal, Climates, Agricultural runoff, Chemical properties

The waste produced by the livestock feeding industry produces a pollution problem for management. The management of a feedlot is affected by physical characteristics of the feedlot, climatic conditions, animal size, animal density and the type of ration fed. Livestock wastes are potential pollutants of (a) surface water, (b) ground water, (c) air, and (d) aesthetic pollution. A discussion of each of these problems is given. The primary general problem in feedlot management is the need for acceptable practices for complete pollution free waste management schemes to replace waste disposal systems. An acceptance of an available method rather than research backed recommendations is the reason for the existing waste management practices. (Kehl-East Central).

## 2077-A7, B1

### AIR POLLUTION AND AGRICULTURE

Department of Plant Pathology,
Arizona University, Tucson
R. L. Caldwell
Proceedings of Agriculture and Pollution Seminar, University of Arizona, Tucson, February 19, 1971 EES Series Report No. 35, p. 66-71. 19 ref.

Descriptors: *Agriculture, *Air pollution, *Arizona
Identifiers: *Pollutants, Sulfur dioxide, Peroxyacetyl nitrate, Ethylene

The relationship between agriculture and air pollution is discussed. Examples of agricultural operations' pollution are animal wastes, grain, feed, fiber and meat processing, forestry operations, pesticide drift, plowing, vehicular travel over unpaved roads, wind blown soil from bare land, aero-allergins (pollens) from a number of plants and the burning of crop residues. A definition of agricultural air pollution injury is given as any harmful effect, whether visible or not, to plant or animals. Injury is defined as damages when it is sufficient to cause an economic loss. Some major air pollutants are sulfur dioxide, peroxyacetyl nitrate, ozone, ethylene and nitrogen dioxide. Their effects on plants and their port of entry into an organism is described. Actions that can be taken to reduce air pollution damage are (1) breeding resistant plant varieties, and (2) chemical protection. The Arizona situation is briefly examined. (Kehl-East Central).

## 2078-A4, A5, F2

### WATER POLLUTION LAWS AND REGULATIONS

Department of Agricultural Economics,
College of Agriculture, Missouri University,
Columbia
C. G. McNabb and D. R. Levi
Science and Technology Guide, Missouri University Columbia Extension Division, May, 1969, 4 p.

Descriptors: *Water pollution, *Regulation, *Missouri, *Permits
Identifiers: *Civil courts, *Injunction, *Fines, *Water Pollution Board

Two approaches for resolution and prevention of the Missouri water pollution problem are (1) through the Water Pollution Board and (2) through the civil courts. In 1957 the Missouri Legislature established the Water Pollution Board, defined water pollution, and adopted a state water policy which the board must regulate. The board was authorized to take legal action against pollution in a number of ways—by fines, by tax bills, by authorization to the Attorney General to bring suit against violators, and by withholding construction permits when proposed waste treatment facilities are inadequate. A permit was to be required for any person wishing to construct, install, or modify facilities for waste disposal which discharge wastes into waters of the state. A person causing pollution may be sued for (1) an injunction, (2) damages, or (3) both an injunction and damages as a civil remedy to temporaory or permanent nuisances. (Battles-East Central).

## 2079-A6, B1, B5, D2
### ODOR CONTROL IN CATTLE FEED YARDS
Consulting Chemical Engineer,
San Marino, California
W. L. Faith
Air Pollution Control Association Journal, Vol. 14, p. 459-460, 1064.

Descriptors: *Odor, *Mechanical control, Legal aspects, Spraying, Disposal, Control
Identifiers: *Feedlots, *Chemical control, Odor counteractants, Masking agents, Disinfectants, Potassium permanganate

This paper deals with the experimental odor control program initiated in 1961 at the Roy F. Benton Feed Yards in Walnut, California, after complaints were received from a nearby residential area. A variety of methods to reduce odor to an acceptable level have been tried with varying results. A highly satisfactory procedure is based on "good housekeeping" practices, frequent removal of fecal material, and abatement of residual odor by spraying the lots at designated intervals with a solution of potassium permanganate. Details of the method are discussed. (Christenbury-Iowa State).

## 2080-A1, B1, F2, F4
### A SUMMARY OF STATE REGULATIONS PERTAINING TO ANIMAL WASTE MANAGEMENT IN THE NORTH CENTRAL REGION OF THE UNITED STATES
Department of Agricultural Economics,
Michigan State University, East Lansing
L. J. Connor, J. B. Johnson, and C. R. Hoglund
Report No. 193. Department of Agricultural Economics. Michigan State University, May 1971, 25 p. 22 ref.

Descriptors: *Regulation, *Animal wastes, *Water pollution, *Air pollution, Economics
Identifiers: *Waste management, *North Central U. S.

The purpose of this report is to provide a summary of present and proposed State regulations pertaining to animal waste management in the North Central Region of the United States. The regulations reported are those in effect or being proposed as of April, 1971. Summary of Regulations of the following states are included: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. State water and Air pollution control agencies for these states are listed. The appropriate State Agencies should be contacted for more complete and detailed information. (Cartmell-East Central).

## 2081-A2, B2, C2, E2
### TRANSFORMATIONS OF SWINE WASTEWATER IN LABORATORY SOIL PROFILES
Department of Biological and Agricultural Engineering, North Carolina State University, Raleigh
L. F. McEver, F. J. Humenik, M. R. Overcash and R. W. Skaggs
Presented at 67th Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-4025, 19 p. 8 fig. 5 tab, 9 ref.

Descriptors: *Soil profiles, *Laboratory tests, Percolation, Nitrogen, Nitrates, Chemical oxygen demand, Water table, Liquid wastes
Identifiers: *Swine, *Wastewater, *Loading rates

The major objective of this study was to investigate the transformations of swine waste lagoon effluent in packed and undisturbed Wagram soil columns with a shallow water table (36 inches). 70 percent of the wastewater nitrogen was converted to nitrate within the rooting zone (upper six inches) for loading rates of one and two inches per week with COD values ranging from 199 to 650 mg/1. While the organic materials moved through the soil with the soil water, a reduction in concentration with increased depth was observed. The organic portion of the swine wastewater was essentially stabilized after one week of storage in the upper soil regions. Almost complete removal (greater than 90 percent) of COD and TOC was recorded for flow through the entire packed and undisturbed soil columns. Mass balances showed no losses in total nitrogen as the wastewater percolated through the soil columns. The low COD to nitrogen ratio of the pretreated wastewater and the preferential removal of organics with soil depth restricted the possibility of induced percolation of carbonaceous substrate to the water table for complete denitrification without supplemental organic addition. (Cartmell-East Central).

## 2082-A5, A8, B1, C1, C2
### WASTE ACCUMULATION ON A SELECTED DAIRY CORRAL AND ITS EFFECT ON THE NITRATE AND SALT OF THE UNDERLYING SOIL STRATA
A. C. Chang, D. C. Adriano, and P. E. Pratt
Journal of Environmental Quality, Vol. 2, No. 2, p. 233-237, April-June, 1973. 2 fig. 3 tab, 25 ref.

Descriptors: *Dairy industry, *Confinement pens, *Nitrates, *Salts, *Soil profile, *Leaching, Groundwater pollution
Identifiers: *Waste accumulation

The objective of this study was to characterize dairy waste accumulation and distribution patterns on the surface of a corral and to evaluate its effect on the nitrate and salt status of the underlying soil strata. Wastes produced to dairy cows on an unpaved earth corral tended to accumulate in a small area near the feed bunk and the water trough. Moisture content of the accumulated waste varied widely with most of the surface covered with relatively dry waste. Comparing raw wastes with stabilized wastes, the accumulated waste was biologically unstable and subject to decomposition when it was wetted. The waste distribution pattern on the corral surface did not influence the movement of chloride and organic matter into the soil profile. Heavy accumulation of wastes created an unfavorable condition for the formation of nitrate which reduced considerably the amount of nitrate that was subject to leaching. Future improvement or redesign of dairy wastes management should take these results into consideration in order to minimize groundwater pollution. (Cartmell-East Central).

## 2083-A10, B3, B4, E2
### DO MANURE STACKS ADD TO FLY CONTROL PROBLEMS?
Department of Entomology,
Wisconsin University
W. L. Gojmerac
Hoard's Dairyman, Vol. 116, p. 556, May 1971

Descriptors: *Breeding, *Dairy industry
Identifiers: *Fly control, *Manure stacks, Land spreading

A study was made of farms stacking manure. The object was to make a comparison of the fly situation between farms storing manure and those hauling regularly. A trained university student accompanied a number of dairy plant field men on their routine farm calls. He inspected each farm in a systematic fashion with reference to fly breeding only. Out of the 70 farms inspected, 31 had manure piles and 39 removed the manure regularly. It appeared that farms with manure piles did not have a more serious fly problem than those hauling regularly. On farms having manure stacking equipment, the barn cleaner apparently is run more frequently, keeping the gutters clean. Therefore, there was less fly breeding inside the barn. Little fly breeding was found on manure piles. The fly problem appears to be found in other places, such as gutters, mangers, and calf pens. (Cartmell- East Central).

## 2084-A4, A5, F2
### WATER AND WATERCOURSES: WATER POLLUTION LAWS AND THEIR ENFORCEMENT IN OKLAHOMA
Oklahoma Law Review, Vol. 22, p. 317-344, 1969

Descriptors: *Water pollution, *Legal aspects,
Identifiers: *Sources of pollution
*Oklahoma

Water pollution control laws in Oklahoma are presented. A summary is offered of the various factors which determine the existence of pollution and influence the types of legal devices used to meet the pollution problem. Common-law private remedies and public administrative controls are discussed. Emphasis is upon the current state pollution control authority and the enforcement practices of the several state enforcement agencies. The character of the water resources relates to the quantity, quality, and availability of water for use. The major man-made causes of pollution are discharges from municipal sewage systems, runoff from agricultural activities, and the disposal of industrial wastes. Causes of water pollution in Oklahoma are listed as; the petroleum industry, other industry, agricultural sources, and municipal wastes. (Cartmell-East Central).

## 2085-A2, A6, A10, B1, C2, D1, D2, D3, E2, E3, F1
### DAIRY WASTE MANAGEMENT ALTERNATIVES
North Carolina State University
Raleigh
B. L. Carlile, S. H. Dobson, L. B. Driggers, J. M. Falter, G. J. Kriz, et. al.
Cooperative Extension Work in Agriculture and Home Economics. North Carolina State University at Raleigh, 38 p. 4 fig, 15 tab,

Descriptors: *Liquid wastes, *Solid wastes, Agricultural runoff, Lagoons, Irrigation, Drying, Waste water disposal, Dairy industry, Chemical properties, Odor, Pests, Costs, Economics
Identifiers: *Waste management, *Land spreading, Refeeding, Composting, Application rates

This bulletin is designed to help dairy producers meet environmental limitation problems in the most practical and economical way. The first section deals with alternative waste management systems and their various components. Also included are sections on storm runoff control and parlor and milkhouse waste water control. Requirements and methods are given for preventing feedlot runoff and milkhouse waste water from reaching surface waters. A utilization and land requirements section presents guidelines and examples of how much waste can be applied per acre. Odor control and pest control sections provide suggestions and methods for reducing odor and pest problems. An economics section gives cost data and contains a partial budget sheet so that comparisons between the alternative waste management systems can be made. (Cartmell-East Central).

## 2086-A2, A5, A8, B1, C1, C2
### HYDROLOGY AND CHARACTERISTICS OF FEEDLOT RUNOFF
Agricultural Research Service,
USDA, Lincoln, Nebraska
N. P. Swanson

Control of Agriculture-related Pollution in the Great Plains, Seminar, Lincoln, Nebraska, July 24-25, 1972, p. 71-80. 2 fig. 12 ref.

Descriptors: *Hydrology, *Feedlots, *Agricultural runoff, *Soil profiles, Topography, Meteorology, Infiltration rates, Phosphorus, Ammonia, Watersheds, Climate

A potential hydrologic pollution problem of runoff from 51,000 acres of Great Plains' feedlots existed in January of 1971. Rate of delivery of such runoff to streams is related to topographic, meteorological, and hydraulic characteristics in the feedlot area. Study of the agricultural runoff in Nebraska yielded the following hydrologic generalizations: (1) infiltration of pollutants into the soil profile is insignificant or very slow once a manure pack is formed, (2) a local problem of underground water pollution exists, (3) one inch rainfall may be absorbed by the soil manure mixture without runoff, (4) solids losses may be less from a feedlot than from tilled bare soil but moderate rainfall increases initiate much higher solids loss and COD value per unit volume of runoff, (5) rainfall intensity and solids removal directly influence phosphorus removal, (6) ammonia-N and $NH_3$-N contents decrease with continuing precipitation, (7) snowmelt runoff contains more solids than rainfall runoff, (8) following a rainfall, feedlot runoff will start sooner, last longer, contain many more times the P, $NH_4$-N content, and require less time to reach the point of discharge than the discharge from adjacent croplands, and (9) ordinarily it is not necessary to design runoff control facilities within a watershed in relation to fish populations, livestock water sources, and similar resources is most important. (Battles-East Central).

## 2087-A1, A6, A7, A8, A11, A12, B1, F1, F2

### DUST AND ODOR PROBLEMS OF THE FEEDLOT

D.V.M. Montfort Feedlot Company,
Greeley, Colorado
J. Young
Control of Agriculture-related Pollution in the Great Plains, Seminar, Lincoln, Nebraska, July 24-25, 1972, p. 81-86. 7 ref.

Descriptors: *Odor, *Dust, *Feedlots, *Air pollution, Legal aspects, Neutralization, Economics
Identifiers: Malodors

objectionable air pollution is grouped into four categories: (1) human health hazards, (2) animal and plant injury, (3) long-term modification of the earth's climate or ecology, and (4) offenses to persons, due to particulate matter. Air pollution from malodors is a major problem because no specific neutralization chemicals are available and cause-effect relationships are not fully understood. Feedlot malodors have never proven hazardous to human health but can be assumed objectionable when people complain about them. The relationship between the feedlot and the surrounding population can be improved by odor neutralization within feasible economic and application scales. Air pollution in the form of particulate matter or dust has two areas of concern: (1) animal health, and (2) as a public nuisance. Control can entail any one or a combination of mechanical or chemical means and will depend on water availability, available labor force, available source of used oil, etc., concentration rate of cattle in pens, climate, and housekeeping procedures. (Battles-East Central).

## 2088-A1, B1, F4

### ANIMAL WASTE MANAGEMENT IMPLEMENTATIONS EXTENSION CONSIDERATIONS

Regional Extension Specialist, Feedlot Waste Management, Oklahoma State University, Stillwater
M. D. Paine
Control of Agriculture-related Pollution in the Great Plains, Seminar, Lincoln, Nebraska, July 24-25, 1972, p. 87-90.

Descriptors: *Liquid wastes, *Solid wastes, *Feedlots, *Management, Communications, Transportation, Odor, Dust, Waste disposal
Identifiers: *Southern Great Plains, Information sheets, Handbooks

The development of large commercial cattle feedlots has brought about the development of a new kind of livestock manager. Today such a manager is likely to be a graduate of an animal science department at a land grant university. Today's feedlot manager oversees a large staff, makes maximum use of communication and transportation, and is compelled to be innovative in handling problems. But the problems arising from large feedlots require additional assistance. In the Southern Great Plains, the ES-USDA, in cooperation with extension directors, allocated special need funds to an experimental project on feedlot waste management. Objectives of the project were: (1) To provide educational opportunities for feedlot managers to be kept up to date on research and cattle feeding developments, with emphasis on waste management; (2) to assist communication between cattle feeders and research agencies; (3) to provide timely and adequate information on social-legal developments. Three subject matter areas were given priority—odor and dust; liquid disposal; and solid waste disposal. Information sheets on these subjects were to be developed for distribution. A feedlot environmental handbook is also being developed to assist feedlot operators. (Battles-East Central).

## 2089-A4, B2, F2

### ANIMAL WASTE — REGULATORY CONSIDERATIONS

Agricultural Engineer, Robert S. Kerr Environmental Research Laboatory, Environmental Protection Agency, Ada, Oklahoma
L. R. Shuyler
Control of Agriculture-related Pollution in the Great Plains, Seminar, Lincoln, Nebraska, July 24-25, 1972, p. 91-95. 1 tab, 3 ref.

Descriptors: *Water pollution, *Regulation, *Feedlots, *Permits
Identifiers: *Discharge, *Impact statements, *Zero discharge

On December 23, 1970, President Nixon issued Executive Order Number 11574 which directed the Army Corps of Engineers to issue discharge permits under the 1899 Rivers and Harbors Act. On May 25, 1971, EPA administrator William D. Ruckelshaus testified before the House Committee on Agriculture to outline the permit program's application to the confined feeding industry. He felt that the program should be limited to feedlots of 1000 or more animal units which discharge their wastes from a single point source. Permit applications were required to be filed by July 1, 1971. A ruling handed down by Judge Aubrey Robinson, Jr., ordered that environmental impact statements be filed for every permit issued. This rendered the permit program virtually useless due to the monumental manpower problem that the requirement for impact statements created. The ruling may eventually make more comprehensive and workable enforcement of Federal and State water quality standards a reality, however. The judge also expanded the definition of "non-navigable" streams to include streams large enough for recreational boating. Legislation now pending in Congress, in addition to providing funds for much needed expansion of research, development, and demonstration in agricultural pollution control, stipulates the national goal of "zero discharge" by 1985, and provides for clarification of the national permit program to be administered by the EPA. (Battles-East Central).

## 2090-A2, A3, A4, B2, B3, C2, D2, D3, E1, E2

### EUTROPHICATION IN THE GREAT PLAINS

Oklahoma Cooperative Fishery Unit,
Oklahoma State University, Stillwater
R. C. Summerfelt
Control of Agriculture-related Pollution in the Great Plains, Seminar, Lincoln, Nebraska, July 24-25, 1972, p. 97-118. 5 tab, 42 ref.

Descriptors: *Eutrophication, *Great Plains, *Water pollution, *Fertilizers, Feedlots, Nutrients, Irrigation, Agricultural runoff, Effluent, Discharge (Water), Drying, Incineration
Identifiers: *Winterkills, Pit disposal, Land disposal, Fish kills

In the Great Plains area of the United States, an increasing amount of fertilizer has been applied to croplands since 1950. Simultaneously, the percentage composition of nitrogen, phosphorus, and potassium in fertilizers has increased as has the method of irrigation, thus enriching the water systems and causing eutrophication and winterkills. Increased use of commercial fertilizer in this area between 1955 and 1960 has increased N, P, and K concentrations in water systems above the minimum critical level. Eutrophication and winterkills in the North Central States and nitrate nitrogen levels of 55 to 60 percent entering Decator Lake, Illinois originated from fertilizers. Runoff from feedlot production in Kansas accounted for 5 of 27 reported fish kills during 1964. This pollution could have been controlled by use of (1) direct pit disposal of solids, (2) aerobic decomposition followed by either land disposal or drying and incineration or (3) proper location of the feedlot. Environmental standards, public demand for cleanup, and national policy are all burdening the discharger to prove that the effluent is innocuous. State water quality standards require treatment and control of animal feedlot discharge, but advancements in prevention of eutrophication are dependent upon the extra costs involved. (Battles-East Central).

## 2091-E3, F1

### RECYCLING POULTRY WASTE NOT FOR SMALL OPERATOR

Poultry Digest, Vol. 32, No. 378, p. 369, August, 1973

Descriptors: *Recycling, *Economics, *Costs, *Poultry
Identifiers: *Refeeding, *Dried poultry waste

An interagency task force studied the economic feasibility of using processed waste material in poultry rations. Flock sizes in the experiment were 10,000, 50,000, and 80,000 birds. Dried poultry manure was fed in test rations of 0, 12 ½ percent, and 25 percent. Feeding of DPM to a 10,000-layer operation was found to be uneconomical at any level. For the 50,000-layer flock, feeding at the 12 ½ percent level resulted in lower unit cost of 0.3 cents per dozen eggs. For the 80,000-bird flock, costs dropped 0.6 cents. Since about 97 percent of the country's layer operations have fewer than 10,000 birds, only a small group of producers could economically process poultry manure and feed it under today's conditions. (Cameron-East Central).

## 2092-B2, D1, D2, D3, E2

### FARM EFFLUENT—ELECTRICAL DISPOSAL METHODS

Electricity Council Research Centre,
Caponhurst
F. Barrett
Effluent and Water Treatment Journal, Vol. 11, No. 4, p. 207-209, April, 1971. 1 fig.

Descriptors: *Effluents, *Farm wastes, *Suspended solids, *Waste disposal, *Waste treatment
Identifiers: *Electrical disposal methods, *Stabilization pond, *Oxidation ditch, *Electrolytic flotation

The growth of more intensive stock farming has added urgency to the search for efficient, economical and acceptable methods for the disposal of farm effluents. Research has indicated that effluent from a herd of 90-100 cows can be dealt with efficiently and economically by spray aeration in a two section stabilization pond. Pig effluent can be made relatively innocuous by treating it aerobically in an oxidation ditch so that its oxygen demand is materially reduced by biological action. It is a process that avoids odor problems and which requires much less land for the disposal of the residue than would be required for untreated effluent. Electrolytic flotation using hydrogen and oxygen produced by the electrolytic breakdown of a small portion of the water in the effluent to raise the solids to the surface is a suitable low-cost method of overcoming most of the difficulties in the removal of suspended solids from effluent. (Cameron-East Central)

### 2093-A8, B3, D3, E2

### COMPOSTED CHICKEN LITTER SEEMS TO RECLAIM SALT-DAMAGED LAND

Crops and Soils Magazine, Vol. 27, No. 4, p. 24, January 1973

Descriptors: *Salts, *Reclamation, Oil wells, Grasses, Land
Identifiers: *Compost, *Chicken litter, Manure, Application rates

Research was conducted by the University of Arkansas using composted chicken litter to reclaim land that was damaged when salt water from oil wells overflowed onto it. Composted chicken manure was applied at a rate of 6 tons per acre and rototilled into the salt-damaged soil to a depth of about 4 inches. The plot was then seeded to a combination of grasses including switchgrass, millet, bahia, bermudagrass, and lespedeza. Soil tests taken before and after the compost application indicated that the treatment was effective in reclaiming the salt-covered area. Agronomist L. H. Hileman says this reclamation method will also effectively eliminate the salt problem from other sources of salt (such as saline seeps). More research is needed to determine the proper rates of application and to evaluate different types and kinds of compost. (Cameron-East Central).

### 2094-A6, A10, D2

### NEW ODOR CONTROL PRODUCT NOW AVAILABLE

Calf News, Vol. 12, No. 6, p. 29, June 1974

Descriptors: *Odor, *Control, *Bacteria, Feedlots, Farm wastes
Identifiers: SUBDU, Fy larvae

SUBDU, a dried combination of two bacterial enzyme cultures, B. Subtilis and B. thuringiensis Berliner, is a new odor control product for feedlots available from BZD Livestock Products, Inc., Lincoln, Nebraska. The •"manure and waste material digester" can be used to neutralize manure and organic waste odors. The product also aids in controlling fly larvae in manure and litter. According to BZD, it takes about 10 days after initial treatment for the enzyme cultures to work. It may be used to control odors in outdoor lots, confinement buildings and manure lagoons and pits. (Cameron-East Central).

### 2095-B1, C2

### URINARY EXCRETION OF QUINALDINE BY CHANNEL CATFISH

U. S. Fish and Wildlife Service, Fish Control Laboratory, LaCrosse, Wisconsin 54601
J. B. Hunn, and J. L. Allen
The Progressive Fish-Culturist, Vol. 36, No. 3, p. 157-159, July, 1974. 1 fig. 1 tab, 12 ref.

Descriptors: *Urine, *Channel catfish
Identifiers: *Quinaldine, *Excretion, Catheterization, Anesthetic

The study was undertaken to determine the rate of renal elimination of quinaldine following exposure of channel catfish obtained from the National Fish Hatchery, Fairport, Iowa. Following catheterization, the fish were placed in chambers and exposed to 30 mg/1 of the anesthetic for not less than 30 minutes. Quinaldine was excreted in the urine of catfish following exposure to the anesthetic quinaldine sulfate, but the amount eliminated from the fish's body via the gill and/or gut can only be estimated. Urinary excretion of quinaldine was less than 5 percent of the total body residue eliminated during 24 hours of withdrawal in freshwater. (Battles-East Central).

### 2096-A2, A6, A11, B2, D1, E2, F1

### SLATTED-FLOOR SYSTEMS FOR BEEF FINISHING

Tennessee University, Knoxville
J. I. Sewell and J. B. McLaren
Tennessee Farm and Home Science Progress Report 88, Tennessee Agricultural Experiment Station, University of Tennessee, October, November, and December, 1973, 4 p. 4 fig, 2 tab, 6 ref.

Descriptors: *Waste disposal, *Slabs, *Costs, *Odors, Labor, Confinement pens, Cattle
Identifiers: *Floors, *Slatted floor, *Beef production, Facility design, Stocking density, Behavior, Waste accumulation rates

A slatted-floor beef finishing facility was completed at the University of Tennessee Aluminum Company of America (ALCOA) Farm in the fall of 1971. An existing barn was remodeled to provide a means of comparing three floor types — concrete-slab floor, concrete slats and aluminum slats. Data was collected on facility design, costs, stocking density, cattle behavior, odors, manure accumulation rates and manure removal. Labor requirements for manure management on slatted floor and slab floor systems were also compared. After two years of operation the results and observations suggested some advantages for the slatted floor system. The major results and observations were: (1) Liquid waste collected in the pits at 0.73 cubic ft per head per day, (2) Before unloading with a vacuum tank-spreader, agitation of manure in pits was required, (3) Almost no surface runoff was produced by the slat system and (4) Aluminum slats were noticeably cleaner than concrete slats. The concerns associated with the slatted floors are: (1) Higher initial facility costs, (2) Odors for a few days after surface spreading of wastes and (3) The provision of adequate ventilation and air exchange during hot and humid weather, (Kehl-East Central).

### 2097-C1, C2, D1, E3

### SIZE DISTRIBUTION AND NUTRITIONAL VALUE OF SWINE MANURE SEPARATES

Associate Sanitary Engineer, Natural Resources and Environmental Protection Department, Frankfort, Kentucky
S. C. Jett, I. J. Ross, H. E. Hamilton, V. W. Hays
Transactions of the ASAE, Vol. 17, No. 5, p. 965-967, September-October, 1974. 2 fig. 1 tab, 4 ref.

Descriptors: *Nutrients, *Particle size, Separation techniques
Identifiers: *Swine, *Manure separates, Nutrition, Crude protein, Ether extract, Nitrogen-free extract, Ash, Wet screening

The nutrients in manures can be utilized to some extent in animal diets. This study's objective was to determine the extent that a mechanical size separation process can be used to separate the major nutritional components in swine waste. For the manure samples tested, there was remarkable consistency in the distribution of the particle sizes and the four proximate components (crude protein, ether extract (EE), nitrogen-free extract (NFE) and ash) within the size range tested (0.250 mm to 3.36 mm). Considering the manure produced by the swine on all three of the study's rations, more than 83% of the crude protein, 93% of the ether extract and 97% of the ash were contained in manure portions that passed during wet screening through the 0.250 mm screen. The portion of the manure that did not go through the 0.250 mm screen contained more than 68% of the NFE. Therefore, wet screening can be used for the effective separation of NFE from the other proximate components. If it were desirable to concentrate either the crude protein of the NFE portions of the manure, this separation would be useful for formulation of rations containing swine manure. (Kehl-East Central).

### 2098-A4, B2, D3, E1, F1

### TREAT YOUR WASTE RIGHT

G. Warren
Soil Conservation, Vol. 38, No. 6, p. 130-132, January, 1973. 3 fig.

Descriptors: *Waste treatment, *Waste disposal, *Sewage, *Louisiana, *Lagoons, *Streams, *Water pollution
Identifiers: *Animal wastes, *Soil Conservation Service

Rural Louisiana is freeing its streams and countryside from sewage, garbage, and animal wastes. The Soil Conservation Service in cooperation with the Louisiana State Board of Health provides technical help in designing and constructing sewage lagoons and animal-waste systems. The SCS is called on for soil maps and interpretations to help locate sites for both types of systems. A sewage lagoon system at Coushatta not only costs about one-tenth of what a treatment plant costs but it also keeps the sewage from going into the Red River. More than 150 animal-waste systems have been built in the state by dairymen. This type of waste no longer goes into the streams; it goes into the lagoon. (Cameron-East Central).

### 2099-A2, B2, C2, D2

### AMMONIA REMOVAL FROM AGRICULTURAL RUNOFF AND SECONDARY EFFLUENTS BY SELECTED ION EXCHANGE

Battelle Memorial Institute, Pacific Northwest Laboratories
Robert A. Taft Research Center Report No. TWRC-5, March, 1969, 58 p. 19 fig. 7 tab, 33 ref.

Descriptors: *Agricultural runoff, *Effluents, *Ion exchange, *Waste water, Nitrogen, Lime
Identifiers: *Ammonia removal

A selective ion exchange process was developed for the removal of ammonia nitrogen from wastewaters. The process employs a natural zeolite, clinoptilolite, which is selective for ammonium ions in the presence of sodium, magnesium, and calcium ions. The ion exchange equilibria of four zeolites was investigated and clinoptilolite was selected for further study on the basis of its ammonium ion selectively and low cost. A mobile demonstration plant having a capacity of 100,000 gallons per day was designed and constructed to remove ammonia from wastewater. The plant contains facilities for flocculation, sedimentation, powdered activated carbon absorption, disinfection, and mixed media filtration followed by ion exchange and associated regeneration equipment. Operations of the mobile plant with secondary effluent resulted in ammonia removals of 97 and 93 percent at 70,000 and 100,000 gallons per day respectively; thus demonstrating that selective ion exchange provides a highly effective means for removing ammonia from wastewater. (Cameron-East Central).

### 2100-B5, D3, E3

### FACTS ON METHANE PRODUCTION FROM ANIMAL WASTE

Department of Agricultural Engineering, College of Agriculture and Life Sciences, Wisconsin University, Madison
J. C. Converse and R. E. Graves
Bulletin No. A2636, College of Agricultural and Life Sciences, University of Wisconsin, Extension, Madison, July 1974, 4 p.

Descriptors: *Methane, *Recycling, *Energy, *Organic matter, Anaerobic conditions, Nitrogen, Phosphorus, Potassium, Pollutants, Effluent
Identifiers: *Manure, *Bio-gas

This fact sheet outlines information concerning methane production from animal waste. It is possible to produce heating gas from animal manure on crop residues in the form of methane. Constant conditions of temperature, fresh organic matter, pH of 7.0 to 7.6, and anaerobic conditions promote methane production. The equipment required to produce methane is a simple batch-loaded digestor/fed a mixture of organic matter and water. Maximum volume reduction of the infed materials will be 5 percent. The output will not increase the amount of nitrogen, phosphorus, or potassium but it will likely be in a more available form. Pollutants will not be significantly reduced. Manure from a 1400 pound cow would produce about 60 cu. ft. of gas at atmospheric pressure per day. The bio-gas usually contains about 70 percent methane, 30 percent $CO_2$, and a small amount of $H_2S$ and other gases. Not all of the bio-gas energy is available for utilization and no exact figure can be given to how much less the net energy is than the gross energy. The methane gas can be burned in tractors and cars, used for cooking, heating water and buildings, air conditioning, grain drying or operating stationary machines. A typical grain dryer (four million Btu/hr.) would require 3330 cu. ft. of bio-gas compressed to 300 psi for a 10-hour day. Although methane in a concentration of 6 to 15 percent with air is an explosive mixture, research in progress may make this process usable by individual farmers. (Battles-East Central).

## 2101-A7, A11

### EFFECTS OF MANURE GASES AND AERIAL DUST ON PIGS

S. E. Curtis, C. D. Anderson, J. G. Drummond, D. W. Kelley, D. A. Kingdon, et. al.
Proceedings, Illinois Pork Industry Day, Illinois University, Animal Science Department AS-665g, Urbana-Champaign, December 4-11, 1973, p. 24-25. 1 tab.

Descriptors: *Gases, *Dust, *Air pollution, Ammonia, Hydrogen sulfide
Identifiers: *Swine, Respiration, Respiratory-tract, Exposure chambers, Absolute humidity, Swine-finishing houses

The effects of ammonia, hydrogen sulfide, and hog-house dust alone and in various combinations in the air on the performance and respiratory-tract health of healthy growing and finishing pigs were studied in seven trials. The performance trials were conducted in four dynamic-type, air pollutant exposure chambers at 65 degrees F. with absolute humidity the same as or lower than the outside air. The air supply to each chamber was filtered and then pollutants were added to the air as it entered the chamber. No pollutants were added to the control chambers. Ammonia, hydrogen sulfide, and hog-house dust at levels as high as or higher than those normally encountered in enclosed swine-finishing houses had little effect on growth performance of the pigs under these experimental conditions. All pigs were sacrificed for complete post-mortem examination at the end of the trial. Forty-eight littermate pairs of crossbred pigs one to two weeks old were exposed for 10 minutes to air containing aerosolized escherichia coli of a nonpathogenic strain and to ammonia held at 50 p.p.m. The young pigs' ability to clean nonpathogenic escherichia coli bacteria from their lungs was impaired by exposure to ammonia at 60 p.p.m. during the clearance period. Results suggest that the performance of healthy pigs may not be affected by air pollution inside enclosed swine houses, but that the incidence and severity of lung disease in pigs may be related to the stress caused by such irritating air pollutants as ammonia. (Battles-East Central).

## 2102-B2, B3, C2, E2, F1

### FEEDLOT MANURE: SUDDENLY IT'S WORTH MORE

Assistant Farm Management Editor,
Successful Farming
B. Gergen
Successful Farming, Vol. 72, No. 10, p. 24-25, September, 1974. 1 fig. 2 tab.

Descriptors: *Fertilizers, *Nitrogen, *Phosphorus, *Potassium, *Economics
Identifiers: *Manure, *Application rates, *Land disposal, Micronutrients

Manure is worth more than it ever has been due to the monetary value of the nutrients nitrogen, phosphorus, and potassium as well as micronutrients. It is figured that each cow provides 98 lbs. of N per year making it worth $26-$28 in manure nutrients. If 250 lbs. per acre of nitrogen is added to the soil as manure, about 110 lbs. will be available the first season, 50 lbs. the second season and 25 lbs. the third season. Stockpiled manure is more valuable than freshly scraped manure because (1) it undergoes partial composting, (2) it is drier and more granular and can therefore be spread more uniformly and (3) it has a higher nitrogen content per ton. In general, liquid manure systems retain the most nutrients and in a Wisconsin study, liquid manure knifed between rows of crops resulted in up to 5 percent higher yields than did liquid manure plowed under. Most feedlot manure is being sold to contract haulers for about 50 cents to $1 per ton. Ten to 30 tons of manure per acre can be put on soil every year with beneficial effects on crop yields. Manure application should be accurately matched to soil fertility requirements. Laboratory analysis of the manure may be done by commercial soil fertility labs and by many feed product distributors. Tables are given which may be used to estimate application rates when analysis is not available. (Battles-East Central).

## 2103-B1, D1, F1

### SLAB VS. SLAT: AN EXPERT'S OPINION

Calf News, Vol. 11, No. 1, p. 14, July, 1973. 1 fig.

Descriptors: *Confinement pens, *Waste disposal, *Design, *Arizona, Costs, Performance, Feasibility studies, Cattle
Identifiers: *Slab-flume design, *Slotted floor design

Presently two types of cattle confinement designs are being promoted, the slat and the slab. The standard design (the slat) is a slotted floor with a scraper in a pit two feet below the slats. A slab is a concrete floor on a one inch in one foot incline with a two inch opening at the lower sides. The manure is moved downward by the cattle's hoofs and is periodically flushed down a flume. Dick Bunger, president of Corral Industries, Phoenix, is an expert on cattle confinement designs and notes the slab design as $18 to $20 cheaper to build than the slot. Mr. Bunger admits that the slab design may not be as effective because: (1) it will not efficiently handle as many cattle per square feet as the slot (50 percent of space is lost because cattle will lie only in certain positions on a slanting slab), (2) the animals are under more stress (cattle skid on slabs), (3) lightweight cattle probably don't have enough hoof weight and friction to move the manure down the slope. (But this has not been proven yet), and (4) if the flume flushing is neglected or the pump breaks down, flooding will occur. Mr. Bunger cautions cattlemen because slab design of cattle confinement has yet to prove economically feasible. A slab-design building is presently being built to prove Mr. Bunger's beliefs. (Kehl-East Central).

## 2104-A2, A4, A5, A8, B2, B3, B4, E2

### LAND DISPOSAL OF LIVESTOCK WASTE

Cooperative Extension Service
Maryland University,
College Park
H. L. Brodie, and J. T. Kennedy
Agricultural Engineering Release No. 54, Environmental Series No. 5, Cooperative Extension Service, University of Maryland, College Park, 1972, 3 p. 2 ref.

Discriptors: *Water pollution, *Livestock, Lagoons, Erosion, Agriculture runoff
Identifiers: *Land disposal

The production and waste management practices used by farmers determine the extent of water pollution caused by their animal production units. Land spreading of animal wastes is a very effective method of preventing water pollution because of the natural treatment process in the soil. Several means of applying the principle of intercepting and controlling surface and subsurface waters are listed. Watersheds are affected a great deal more by natural pollutants than by animal wastes which are properly spread on land where erosion is controlled. Crop rotation, strip cropping, pasture improvement and the growing of crops for protective cover are the most common erosion control procedures. A list of steps to take in the prevention of pollution from land disposal of livestock wastes is given. Alternate methods of land application during the fall are provided. The best way to judge application rate is from experience by considering slope, slope length, soil type and ground cover. Two obstacles to winter spreading are frozen soil and deep snow. During the winter if a good spreading schedule cannot be followed, the manure should be stored under cover. Additional information on managing lagoons to capture runoff and minimize overflow is provided. If animal production units are properly located and managed, groundwater problems are minimized. (Kehl-East Central.)

## 2105-A4, A5, A6, B2, D3, E1

### LAGOONS FOR ANIMAL WASTE DISPOSAL

Cooperative Extension Service
Auburn University
Auburn, Alabama
H. Watson
Cooperative Extension Service Circular R-6, Auburn University, July, 1972, 12 p. 6 tab, 3 ref.

Descriptors: *Waste disposal, *Lagoons, *Design, *Management, *Biochemical oxygen demand, Poultry, Livestock.
Identifiers: Water volumes, Sludge removal, Lagoon overflow, Loading.

For several years lagoons have been used for the disposal of livestock and polutry manure with varying degrees of success. A lagoon's effectiveness is determined by its design, construction and management. The two major advantages of lagoons are: (1) the labor requirements are less than for systems where manure is spread onto fields and (2) lagoons usually can be constructed at a low initial cost. There are three major disadvantages of lagoons. (1) Objectionable odors are sometimes present, (2) Improper construction can present a possible source of ground and surface water pollution, and (3) Periodic sludge removal is required. The processes of three lagoon types, aerobic, anaerobic and mechanically aerated lagoons, are discussed. The location, size and construction are examined as important factors in lagoon design. Tables for BOD production and surface area requirements, water volumes for various aerator sizes and for water volume of various anaerobic lagoons are given. The operation and management of a lagoon are explained through the various loading methods, sludge removal and lagoon overflow. Some general management practices that should be followed are given. (Kehl-East Central)

## 2106-A6, B2, C1, C2, C3,

### EVALUATION OF METHODS FOR THE ANALYSIS OF PHYSICAL, CHEMICAL AND BIOCHEMICAL PROPERTIES OF POULTRY WASTEWATERS

Department of Agricultural Engineering
Cornell University
Ithaca, New York
T. B. S. Prakasam, E. G. Srinath, P. Y. Yang, and R. C. Loehr.
Presented at Special Meeting, American Society of Agricultural Engineers Committee SE-413,

Chicago, Illinois, December 12, 1972, 71 p. 9 fig. 16 tab, 15 ref.

Descriptors: *Research and development, *Analytical techniques, *Poultry, *Physical properties, *Chemical properties, *Waste treatment.
Identifiers: *Wastewaters, *Biochemical properties, Nitrogen control, Odor control.

Research and demonstration studies were conducted on the treatment of poultry wastes for the past four years with particular emphasis on nitrogen control, waste treatment, and odor control. This research involved the analysis of raw and treated wastewater. Analytical methods were evaluated for their applicability to the routine analysis of animal and especially poultry wastewaters. Objectives of this research were to discuss the results of these investigations and to indicate satisfactory methods for the analysis of physical, chemical, and biochemical properties of poultry wastewaters. Samples of excreta voided from chickens housed at the Poultry Research Farm, Cornell University were used. The various methods used for the analysis of raw and treated poultry wastewater are described. (Cameron-East Central)

## 2107-B2,B3,D1,D3,E2,E3

### FEEDLOT RECLAMATION "CLOSED SYSTEM"—WASTE RECOVERING: INSULATED

C. Gross
Calf News, Vol. 13, No. 2, p. 36-37, February, 1975, 4 fig.

Descriptors: *Design, *Construction, *Feedlots, *Farm wastes, Bacteria, Confinement pens, Recycling, Heat.
Identifiers: *Closed systems, *Recovery process, Composting, Refeeding.

Jim Jarnagin, with financing from the Kansas Farm Life Insurance Co., built a by-product recovery confinement system, examples of which had already been built by Corral Industries. Running down the structure's 1,140-foot length is a 16-foot-wide alley flanked on the north and south by a row of pens. At a stocking rate of 5,040 head, each animal has 20 square feet of space. The design and construction of the structure are given. After separation of liquids and solids, the processed solid waste is augered to a compost pile, where it remains for two days. After 24 hours, heat pasteurized the compost reducing the pathogens and yielding a product named CI 13. Since the bacterial kill in the recovery process is substantial, the material can be immediately blended back into the ration, or it can be composted until needed. The liquid fraction from the separation process is pumped into a pond. From here it goes out to the fields through a gated pipe sprinkler irrigation system. (Cameron-East Central.)

## 2108-A5, B2, C2, D3, E2

### NUTRIENT TRANSFORMATIONS IN A SWINE WASTE OXIDATION DITCH

Department of Civil Engineering
Institute of Environmental Sciences and Engineering.
Toronto University, Ontario, Canada.
P. H. Jones and N. K. Patni.
Journal Water Pollution Control Federation, Vol. 46, No. 2, p. 366-379, February, 1974. 16 fig. 4 tab, 20 ref.

Descriptors: *Waste treatment, *Phosphorus, *Nitrogen, Design, Swine.
Identifiers: *Oxidation ditch, Land disposal.

Livestock production in confined areas is rapidly gaining popularity in North America as well as in Europe. Of the various possible systems for the treatment and handling of high-strength animal wastes, oxidation ditches are especially attractive because of their simplicity and economy. Jones, Patni and others have established the efficiency of oxidation ditches in reducing oxygen demanding carbon. This seven month study examines the behavior of nitrogen and phosphorus in such units. Nitrogen loss from the ditch was inhibited after about 20 weeks of operation as indicated by nitrogen accumulation in the ditch mixed liquor (DML). It seems that the nitrification-denitrification scheme was distributed by the introduction of wood shavings in the DML beginning about this time. It is concluded that, with proper design and operation, oxidation ditches can be used to effect a high degree of nitrogen removal from high-strength animal wastes. The study also indicated that controlled and regulated land application of the animal wastes treated in oxidation ditches (containing the accumulated phosphorus) seems at present to be the most practical way of preventing phosphates from reaching groundwater at animal waste treatment facilities. (Kehl-East Central.)

## 2109-A2, A3, C2

### CHARACTERISTICS AND COMPARATIVE MAGNITUDE OF NON-POINT SOURCES

Cornell University
R. C. Loehr
Journal Water Pollution Control Federation, Vol. 46, No. 8, p. 1849-1872, August, 1974. 2 fig. 17 tab, 59 ref.

Descriptors: *Precipitation (atmospheric), Phosphorus, Nitrogen, Ecology.
Identifiers: *Non-point sources, *Runoff, *Pollution, Irrigation return flows, Seepage, Cropland tile drainage.

Definite comparisons of non-point sources are difficult since such comparisons are the result of complex interactions in and on the soil. Identification of non-point sources was based on the reported range of their characteristics and the available technology for their control. They were identified as (1) those not needing control or uncontrollable, (2) those possibly needing control, and (3) those requiring control. The first category included precipitation, unmanaged forest land runoff, and range land runoff. The second one contained crop land runoff, runoff from land receiving manure, crop land tile drainage, and irrigation return flows. The final category included urban land runoff, manure seepage and feedlot runoff. The relative contribution of sources in a watershed will be determined by the human activities that are there. (Kehl-East Central)

## 2110-B5, C3

### TOXICITY OF SEAWATER TO COLIFORM BACTERIA

Graduate Student
Civil Engineering Department
Washington University
Seattle
H. P. Savage and N. B. Hanes
Journal Water Pollution Control Federation, Vol. 43, No. 5, p. 854-861, May 1971, 16 fig. 1 tab, 16 ref.

Descriptors: *Toxicity, *Seawater, *Coliforms, *Bacteria, *Nutrients, *Biochemical oxygen demand.

This study was undertaken to examine the effect of nutrient levels as measured by BOD analysis, on the toxicity of seawater to total coliforms and fecal coliforms. Three separate experiments were performed. Flasks labeled "condition A" received no additional nutrients resulting in a BOD of between .6 and 1.8 mg/l. Total and fecal coliforms died rapidly in "condition A". "Condition B" consisted of flasks with a moderate concentration of waste water nutrients. The resulting BOD levels ranged from 9.9 to 20 mg/l. Initially, fecal and total coliforms generally increased their share of the total bacterial population and then their proportion declined steadily. The flasks of "condition C" contained a high concentration of wastewater nutrients. The resulting BOD levels were between 101 and 120 mg/l. Again, bacterial populations increased, and then their proportions declined rapidly. (Cartmell-East Central)

## 2111-A4, A6, B2, D1

### AGRICULTURAL RESEARCH CONCENTRATES ON FARM WASTE

New Scientist, Vol. 59, No. 856, p. 198, July 26, 1973.

Descriptors: *Farm wastes, *Effluent, *Slurries, *Waste treatment, *Regulation, *Great Britain, Economics, Reclamation.
Identifiers: *Research, Water pollution.

Scientists in Great Britain are using straw, hessian sacking, and even hedge-clippings, all of which are freely available in large quantities on most farms, in an effort to cut the cost of farm effluent charges. The aim has been to concentrate on the most extreme of farm slurry problems. Effluent from animals is one of the biggest problems farmers have to face. There is legislation to clamp down on farmers' methods of disposal if pollution of the water or the air infringes the regulations, but with few inspectors to check on what is happening in rivers and streams the law is often broken. In Silsoe they treat slurry by mechanical separation of the solids content from liquid for easier handling and aerobic treatment of the liquid to kill the smell. The process and costs involved are discussed in detail. (Solid Waste Information Retrieval System).

## 2112-B2, B3, D3, E3, F5

### SHORT CUTS FROM MUCK TO MEALS

New Scientist, Vol. 56, No. 821, p. 456, November 23, 1972.

Descriptors: *Feeds, *Reclamation, Effluent, Fish, Algae, Mollusks, Economics.
Idenitfiers: *Refeeding, *Great Britain.

This article outlines ways of using farm waste as feedstuff. One way is to push farm effluent into a pond to produce plankton which in turn supports fish, which are then harvested. Another possibility is to use not fish but bivalve mollusk, whose entire anatomy and physiology is designed to filter out nutritious particles. The nutritionally valuable algae could also be raised on effluent. The algae would also be useful as generators of oxygen. Beef cattle are already being fed on pellets of chicken dung. This not only disposes of unpleasant wastes, but also saves the farmer feed costs. (Solid Waste Information Retrieval System).

## 2113-A8,B2,B3,C2,E2,F4

### EFFECTS OF APPLICATION RATE IN DIRECT LAND DISPOSAL OF ANIMAL WASTES

Department of Agronomy, Kansas State University, Manhattan 66506.
L. S. Murphy, G. W. Wallingford, and W. L. Powers.
Journal of Dairy Science, Vol. 56, No. 10, p. 1367-1374, October, 1973. 8 fig, 4 tab.

Descriptors, *Effects, *Solid wastes, *Liquid wastes, Feedlots, Dairy industry, Soils, Chemical properties, Nitrates, Salinity, Phosphorus.
Identifiers: Application rates, Land disposal, Colloidal dispersion, Pollution.

Land disposal of animal wastes is a viable solution to the water pollution problem, but this disposal must be done with care so that new pollution problems don't arise. Excess application of manure can cause excess salinity, nitrates, and/or phosphorus as well as colloidal dispersion. A literature review is given to show the beneficial and detrimental value of manure applications on crops and on soil chemical properties. It was concluded that disposal of both solid and liquid wastes should be accompanied by regular soil analysis to detect accumulation of waste components or reaction products which may be detrimental to both the soil and to underlying aquifers. (Battles-East Central).

## 2114-A2, A6, A7, B2, B3, B4, D3, E3

### CONTROLLING MANURE RUNOFF

Pennsylvania State University
A. R. Grout
Feedlot Management, Vol. 16, No. 6, p. 34 35, 38, June 1974. 1 fig.

Descriptors: *Agricultural runoff, *Feedlots, *Slurries, *Liquid wastes, Lagoons, Basins, Methane Costs, Odor.
Identifiers: *Runoff control, Oxidation ditch, Evaporation pond, Composting, Dewatering.

There are several ways in which feedlot runoff may be controlled. Slurry manure can be stored in an open basin. Because this material will not stack, the walls must be high enough and strong enough to hold the semi-liquid manure inside. Solid manure from a bedded barn of partially dried manure from a feedlot can be stored with a stacker unit in a basin. In liquid manure systems slotted floors or concrete slabs can be used for removal of manure, and problems due to cold weather. Agricultural runoff can be reduced by roofing, diversion channels, and efficient evestrough systems. Detention ponds for runoff should be built according to state guidelines. Lagoons or stabilization ponds can cause a partial break down of manure nutrients in water. In oxidation ditches liquid manure is circulated and aerated in a race-track shaped basin by a paddle wheel or propeller. Evaporation ponds reduce the amount of water for disposal, but are limited to areas of low humidity and rainfall. Composting and dewatering of solids is being practiced in some areas. Production of methane gas from animal manure by anaerobic digestion is another disposal alternative. (Cartmell-East Central)

## 2115-B3, B5, D2, E3

### ENZYMES DIGEST FIBER IN RECYCLED MANURE

Poultry Digest, Vol. 32, No. 377, p. 318, July, 1973.

Descriptors: *Recycling, *Poultry, Enzymes, Heat.
Identifiers: *Refeeding, *Dried poultry manure, *Digestibility.

While processed poultry manure has given satisfactory results when fed to ruminants, refeeding of it to poultry has been questioned due to its fiber build-up and low energy value. However, Dr. Sloneker (USDA) feels that processed poultry manure can be refed as 25% of a poultry ration through 23 cycles. He feels that fermentation of the manure and chemical decomposition caused by drying break down the fiber and make it more digestible. Improvement of these enzymatic and heat accelerated changes point the way to total recycling with minimum pollution, (Battles-East Central)

## 2116-D2, E3, F2

### FEED PRICES, ENVIRONMENTAL LAWS HELP SALES OUTLOOK FOR DRYING EQUIPMENT, DPW

Feedstuffs, Staff Editor
G. Emerson.
Feedstuffs, Vol. 47, No. 4, p. 32, 62, January 27, 1975. 1 fig, 1 tab.

Descriptors: *Equipment, *Drying, *Poultry, *Costs, *Feeds, *Fertilizers, *Legislation.
Identifiers: *Dried poultry waste, *Food and Drug Administration, *Refeeding.

Incentives for mechanically drying poultry manure (DPW) are financial and environmental. Two types of producers are buying dryers — those who are about to be legislated out of business and those who have an immediate need or market for DPW as a feed or fertilizer. The Food and Drug Administration has not yet approved the use of DPW as a feed ingredient, but equipment firms believe that if and when it does, the markets for both equipment and the finished product will grow rapidly. There are mare than 25 brands of dryers on the market. Costs of the units range from 13,000 to 200,000. The number of birds needed to justify cost of the system varies, but the most frequent mentioned number is 100,000. The cost of producing a ton of DPW ranges from $45 to $50, depending on moisture content of the manure, fuel cost, and dryer efficiency. The quality of DPW depends upon the diet fed to the poultry, the age of the manure, and the quality of the dryer. Currently, the selling price of DPW ranges from $45 to $120, depending upon the area of the country and whether a demand from nearby feedlots exists. (Battles-East Central)

## 2117-A2, A8, B2, E2

### FEEDLOT RUNOFF DISPOSAL ON GRASS OR CROPS

Associate Professor, Agricultural Engineering Department, Oklahoma State University.
A. F. Butchbaker.
Prepared by the Regional Extension Project for Feedlot Waste Management, No. 7521, TX: L-1053, 6 p. 3 fig, 4 tab, 2 ref.

Descriptors: *Feedlots, *Agricultural runoff, Irrigation, Costs, Labor, Odor, Salinity, Permeability, Nutrients.
Identifiers: *Land disposal.

The runoff control system begins in the feedlot by providing good drainage and a collection system for conveying the runoff. A settling basin should be used to remove at least 50% of the solids. The liquid should pass through the settling basin and go to a holding pond from which it will be pumped to the field disposal site. The two basic types of liquid disposal are sprinkler and surface distribution. Runoff containing more than 5% solids and up to 15% can be handled by only one system, the manure gun sprinkler. Among the advantages of pumping runoff to the field are: (1) For large amounts of livestock, pumping is economical and labor-saving. (2) Pumping runoff onto crops or grass salvages many nutrients. (3) The runoff can be applied throughout the growing season. Thus, liquid disposal on grass allows nearly year around application of runoff in the southern plains region, (4) The odor problem may be increased, depending upon management. (5) Some salt or other toxic compounds in the runoff, if applied by sprinklers, may deposit on plant leaves, reducing the photosynthesis rate. (6) Tight soils may not have high enough permeability to receive the liquid rapidly. (7) Salinity buildup on the soil is a potential problem. Maximum permissible application rates have not yet been determined. (Battles-East Central)

## 2118-A11, B2, B4, F1

### FREE STALL HOUSING AND LIQUID MANURE MANAGEMENT FOR THE ENTIRE DAIRY HERD — SYSTEMS APPROACH

Agricultural Engineering Department, College of Agricultural and Life Sciences, University of Wisconsin, Madison.
G. D. Barquest, T. J. Brevik, J. C. Converse, C. O. Cramer, H. J. Larsen, et al.
Progress Report, Project No. 5023, College of Agricultural and Life Sciences, University of Wisconsin, Madison, 27 p, 9 fig, 14 tab.

Descriptors: *Dairy industry, *Liquid wastes, *Costs, *Performance, Lagoons, Ventilation, Comparative benefits, Floors.
Identifiers: *Free stall housing, Mastitis, Insulated housing, Uninsulated housing, Slatted floors, Floor scraper.

Three 20 cow free stall barns were compared over a two year period at a Wisconsin University Experimental Farm to determine the effects of three types of free stall housing and two liquid manure systems on cattle health, production, and facility requirements. Barn A was insulated and mechanically ventilated and had slatted floors and an underfloor manure tank. Unlike Barn A, Barn B had solid concrete alley floors with an automatic floor scraper. Barn C was enclosed but uninsulated and had solid floors and a floor scraper. Barns A and B averaged about 40 degrees F. during the coldest weather. The temperature in Barn C fluctuated with the outdoor temperature but ranged 15 tc 29 degrees higher. Barn C cattle had a slightly higher incidence of mastitis and a slight reduction in dry matter intake. The cows preferred deep bedded free stalls with dirt bases to rubber mat stalls, carpeted stalls, or concrete stalls; however, the deep bedded stalls required more bedding and labor. For three of the four periods the volume of manure removed from the lagoon was greater than the amount pumped into it due to heavy rainfall and snow accumulation. However, during one relatively dry summer period a reduction in volume of 18 percent occurred. An average of 3.77 cu, ft./cow of milking center wastes, precipitation, manure and bedding was removed from the total system during the two year period. Total solids content of the manure was 7.4 percent for the underfloor tank and 4.8 percent for the storage lagoon. The initial investment and annual costs were about $200 and $20 per cow. Investment and costs were less for the floor scraper—storage lagoon system than for the slotted floor-underfloor tank. (Battles-East Central)

## 2119-A6, B1, D2, D3

### CHEMICAL CONTROL OF MANURE ODOR

Regional Extension Specialist, Feedlot Waste Management, Oklahoma State University.
M. D. Paine.
Unpublished paper, 4 p.

Descriptors: *Odor, Enzymes.
Identifiers: *Chemical odor control, *Manure, *Matching Standards Techniques, *Index of Similarity, Masking agent, Counteractant, Deordorant, Digestive Deodorant.

There are four main types of odor control agents. In the order of decreasing effectiveness these types are: (1) masking agents, (2) counteractants, (3) deodorants, and (4) digestive deodorants. Masking agents are mixtures of aeromatic oils which cover the odor but do not reduce it. Counteractants neutralize the odor with aeromatic oils leaving no overriding odor. A deodorant is a mixture of chemicals that "kill" the odor without the use of another "cover" odor. Digestive deodorants consist of a combination of digestive enzymes, aerobic and anaerobic bacteria that create a digestive process that eliminates the odor. Evaluation of the effectiveness of odor control agents is done by the Matching Standards Technique which requires a testing panel of 8 to 10 people who compare the smell of manure samples and score the control agents from 0 (Most effective) to 8 (least effective). Using this data, a comparison of two agents by an Index of Similarity is possible. Additional information on the Matching Standards technique and on the ratings of odor control products that have been tested can be obtained from Extension Agricultural Engineers in the Great Plains. (Battles-East Central)

## 2120-A2, B2, F1, F2

### THE HIGH COST OF RUNOFF CONTROLS: IS HELP NEEDED?

The Furrow, March, 1975, p. 14-15.

Descriptors: *Costs, *Agricultural runoff, *Control systems, *Feedlots, Livestock.
Identifiers: *Cost sharing, Rural Economic Assistance Program.

New state and federal laws governing runoff control from feedlots will be costly for all livestock producers and may force the smaller ones out of business. Michigan State University economists estimate that runoff controls would cost from $3.98 to $14.37 per head for feedlots with 1,000 head or more, and they could run higher for smaller operations. USDA economists estimate control costs for northern areas could cost $25 per head for a 150-cow dairy and more for smaller dairies. The USDA approved a cost-sharing program (REAP) in 1973 which enabled a producer to receive up to 80 percent of the total cost for runoff controls with a maximum of $2,500. The $2,500 ceiling on funds provides little relief for the impact of control costs of large feedlot operations; however, large operations can pass these costs on to consumers more easily than smaller operations. Cost sharing programs for 1975 are questionable because there were no cost-sharing programs in 1974. (Battles-East Central)

### 2121-A8, B3, E2

## EFFECT OF SOIL APPLICATION OF DAIRY MANURE ON GERMINATION AND EMERGENCE OF SOME SELECTED CROPS

Department of Crop and Soil Sciences
Michigan State University
East Lansing
D. C. Adriano, A. C. Chang, P. R. Pratt, and R. Sharpless.
Journal of Environmental Quality, Vol. 2, No. 3, p. 396-399, July/September, 1973. 1 fig., 3 tab, 13 ref.

Descriptors: *Dairy industry, *Feedlots, *Waste disposal, *Germination, *Crop response, *Plant growth.
Identifiers: *Land disposal, *Application rates, Salt injury, Toxicity.

Application to irrigated fields is the most common method of dairy and beef manure disposal in southern California. Considerable concern has developed recently as to the possible environmental problems that could arise from application on fields of large amounts of these manures, especially in areas of concentration of dairies and feedlots. This study's primary objectives were: (1) to evaluate the effect of various dairy manure treatments on the germination of several crops, and (2) to elucidate the possible causes of the germination injury. The crops used in the study were sudangrass (Sorghum sudanese Stapf 'Piper'), barley (Hordeum vugare L. 'Numar'), radish, (Raphanus sativus L. 'Cherry Belle'), and spinach (Spinacea Cleraces L. 'Bloomsdale'). The experiment was carried out in a glasshouse using Chino loam soil and adding various amounts (0, 5, 10, 15, and 20 percent dry manure by weight) of dairy manure. The degree of germination injury was dependent on crop species and application rate of the salt and N. Spinach and radish were more sensitive to salt or $NH_3$ than barley and sudangrass. Barley germination data from various treatments suggest that the germination injury was not salt specific. The study concluded that by planting several days after soil application of large amounts of dairy or feedlot manure or after adequate preirrigation, or both, germination injury can be minimized. (Kehl-East Central)

### 2122-A11, B1, B5, F1

## CONFINEMENT HOUSING SYSTEMS FOR SOWS

Department of Agricultural Engineering
Illinois University
Urbana-Champaign
A. J. Muehling and G. R. Carlisle.
Presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-920, 14 p. 6 fig, 6 ref.

Descriptors: *Confinement pens, *Breeding, *Waste disposal, Farm management.
Identifiers: *Sows, Swine, Feeding.,

The number of pork producers has declined while the size of swine production enterprises has grown. This has resulted in economic forces dictating a move toward confinement on many farms. Recently, considerable interest has also been given to confining the breeding herd. An examination of the advantages and disadvantages of sow confinement is given. One advantage is that it made possible better environmental control and more precise waste management. Mud and dust problems are almost completely eliminated in a confinement system. Extremely high environment temperatures greatly affect a pregnant sow at the beginning and end of the gestation period. A well-designed and well-managed system will modify these effects. Sow confinement also gives the producer control over waste disposal. Observations of six confinement syetems are given. These systems are: (1) an open-front shed with an outside run, (2) a totally enclosed building with partially slotted floors, (3) an open-front, partially slotted-floor building, (4) an all-slotted-floor gestation building, (5) a totally enclosed, partially slotted-floor building with a separate breeding area, and (6) a totally slotted-floor building with individual stalls. Design decisions connected with these systems and costs are given. It was concluded that each producer would have to decide which system or combination of systems would best suit his needs. (Kehl-East Central)

### 2123-A11, B3, C3, E3, F1

## DPM FOR RUMINANTS GROWS IN ENGLAND

Poultry Digest, Vol. 32, No. 377, p. 318, July, 1973.

Descriptors: *Proteins, *Costs, Feeds.
Identifiers: *Dried poultry manure, *England, *Refeeding, Bacterial contamination.

According to Poultry World, February 15, 1973, the use of dried poultry manure (DPM) in rations for ruminants is increasing in England. Research at several of the experimental farms of the British Ministry of Agriculture has shown that not only is DPM an effective protein source in both dairy and beef rations, but it has resulted in feed cost savings. Poultry World has stated that provided the residue is dried at high temperatures, there appears to be no danger from harmful bacterial contamination. Residue tests have shown only minute traces which do not present a hazard. However, in the United States, the Food and Drug Administration has not yet approved the use of dried poultry manure in feeds. (Kehl-East Central)

### 2124-A2, A8, B2, B4, E2

## DESIGN AND OPERATION OF A FEEDLOT RUNOFF DISPOSAL SYSTEM—A CASE STUDY

Agricultural Research Service
U.S. Department of Agriculture
Nebraska University
Lincoln
J. A. Nienaber, C. B. Gilbertson, T. M. McCalla, and F. M. Kestner.
Presented at 1973 Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-432, 16 p. 1 fig, 6 tab, 11 ref.

Descriptors: *Design, *Feedlots, *Agricultural runoff, *Waste disposal, Nutrients, Crop production, Cattle.
Identifiers: *Runoff control.

Several methods have been devised for the control of runoff from outdoor beef cattle feedlots. A runoff-control facility has three major components including a solids settling area, a temporary liquid storage area and a disposal area. The objective of this study initiated in 1970 is to determine the minimum area required to dispose of runoff as affected by applied nutrient and water and disposal area runoff control requirements. The research was conducted on a cooperator site with a 1000-head feedlot and runoff control facility. The study discovered under the conditions tested, that a minimum area of one-half acre disposal per acre of feedlot does not cause a pollutant accumulation in the soil profile or impair crop production. Area required, system components and their operations, and collection of disposal area runoff were included in a final design. (Kehl-East Central)

### 2125-A11, B1, E3, F2

## CATTLE, POULTRY PRODUCERS PUSH FOR RECYCLING RULES

Feedstuffs Southeastern Correspondent
R. H. Brown
Feedstuffs, Vol. 47, No. 11, p. 9, 67-68, March 17, 1975.

Descriptors: *Cattle, *Poultry, *Animal wastes, *Recycling, Feeds.
Identifiers: *Refeeding.

Cattlemen are searching for cheaper feedstuffs for cattle because of market demands and because of consumer objection to feeding feedstuffs to cattle that can be used directly by man. Recycling of waste materials would help reduce the waste problem and provide some economic relief for the cattlemen. Dr. O. W. Charles of the Georgia Extension Service has completed an environmental impact study on waste materials for presentation to the Food and Drug Administration. The study revealed that there are more than two billion tons of wet waste material which must be disposed of. Semi-optimistic predictions exist as to when the FDA may publish regulations. Charles pointed out that environmentalists will probably file suits against recycling when regulations are issued. Because feeders have already moved ahead of researchers in feeding recycled waste and because states may issue regulations, the FDA may be moving a little faster than in the past to get regulations passed. Currently, negotiations are concerned with the Bureau of Foods. When agreement is reached between this agency and the FDA's Bureau of Veterinary Medicine, the proposed regulations may reach the Federal Register. Vegetable materials from processing plants and hydrolized proteins are other waste materials being studied as probable recyclable wastes. (Battles-East Central).

### 2126-B1, C1, C2, C3, D2, D3, E2, E3, F4

## AGRICULTURAL WASTES

Mississippi State University, State College.
J. L. Mahloch and E. C. McGriff Jr.
Journal Water Pollution Control Federation, Vol. 46, No. 6, p. 1280-1283, June, 1974. 20 ref.

Descriptors: *Livestock, *Properties, *Waste treatment, *Waste disposal, Bacteria, Nutrients.
Identifiers: *Literature review, *Agricultural wastes, Pyrolysis, Refeeding, Land disposal.

A literature review is given of studies concerning the characterization of livestock waste and its impact, design of treatment systems, use of land disposal, and reuse capabilities. Isolation of bacteria, waste accumulation rates, pyrolysis of wastes, nutrient removal in waste treatment ponds, various waste treatment systems, effect of land applications on crops, and refeeding are just some of the topics considered in this review. The applicability of this current research is affected by current and proposed control regulations and the viability of the agricultural sector of the economy. (Merryman-East Central)

### 2127-A5, A8, B2, E1

## SEALING OF ANAEROBIC DAIRY WASTE LAGOONS IN SANDY, HIGH WATER TABLE SOILS

Graduate Assistant
Department of Agricultural Engineering
Florida University
Gainesville
C. G. Osterberg
Unpublished MS Thesis, Florida University, Gainesville, 1972, 75 p. 20 fig, 20 tab, 14 ref.

Descriptors: *Soils, *Water, *Florida, *Dairy industry, Waste treatment, Sampling, Analysis, Seepage, Flow rates, Sands, Groundwater, Nutrients.
Identifiers: *Sealing, *Anaerobic lagoons, Loading rates, Hydraulic head, Microbial activity, Manure.

A study was done to investigate the physical and biological sealing mechanism of anaerobic dairy wastewater ponded over highly permeable Florida fine sand. The effects of hydraulic head, manure loading rate and inhibited microbial activity were studied. Graphic analysis showed that the column receiving manure experienced a rapid reduction of flow rate to approximately 45 percent of the initial flow for the low loading rate and to 12 percent of the initial flow for the higher loading rates. After 113 days of manure loading, flow rate returned to 50 percent of the initial value for the low loading rate and to 30 percent for the higher rates. Little effect of hydraulic head on flow rate could be detected in the 15 cm. to 60 cm. range studied. The ultimate degree of soil sealing appears to depend on manure loading rate, although long term testing is needed to determine if the ultimate sealing is related to the rapid sealing trend observed after several days of manure loading. (Cameron-East Central)

### 2128-B5, C2, D2, D3, F6

### ANAEROBIC DIGESTION OF CHICKEN MANURE

A. C. Anthonisen
M. S. Thesis, Department of Civil Engineering, Clarkson College of Technology, Potsdam, New York, September 24, 1965, 78 p. 18 fig, 11 tab, 36 ref.

Descriptors: *Anaerobic digestion, *Poultry, *Mathematical models, Gases, Chemical properties, Sodium chloride, Sludge.
Identifiers: *Ammonia nitrogen, Loading rates, Detention time.

The purposes of this investigation were to determine the feasibility of treating chicken manure by anaerobic digestion, to determine the effect of a cationic antagonist on such digestion, and to analyze the kinetics of the anaerobic process through use of a mathematical model. The results of this research have indicated that further research is needed before definite conclusions may be drawn. However, anaerobic digestion of chicken manure appears to be feasible under carefully controlled conditions. These conditions include: pH — 7.4, volatile acids—1500—above me/1 as acetic acid, alkalinity—1000—12000 mg/1 as calcium carboniate, ammonia nitrogen—1500 mg/1, detention time—20 days, loading—.088 (lb. V.S./cu. ft. of volume day), temperature—35° C, and Sodium Chloride additions. It was concluded that high ammonia nitrogen concentrations are toxic to anaerobic digestion addition of sodium chloride to a digester with high ammonia nitrogen concentrations appears to increase gas production, and gas from chicken manure digestion is burnable. (Cartmell-East Central)

### 2129-B5, E3, F1

### DPW SAVES $26.75 PER TON OF LAYER FEED

Poultry Digest, Vol. 32, No. 378, p. 345, August 1973.

Descriptors: *Costs, *Economics, *Feeds, *Poultry.
Identifiers: *Dried poultry waste, *Refeeding.

Layer operators could have saved $26.75 per ton by substituting DPW for corn at a rate of 13 percent of total ration. These figures were based on June 11 feed prices at Atlanta. Dr. O. W. Charles, extension poultry nutritionist, University of Georgia, using a typical layer ration, provided figures to a computer and allowed it to select ingredients which would provide the same nutritional values for the typical ration and the DPW ration. Typical ration cost was $148.30 as compared to $121.55 for the DPW ration, with the DPW ingredient assigned a value of $63.60 per ton. According to Dr. Charles, DPW varies in its chemical composition and biological value because of difference in the methods of handling and processing DPW and in the diet of the hen. "Valuable materials can be processed from DPW," Dr. Charles stated, "If it is properly handled, DPW does have a significant value in a laying hen ration, If it is poorly handled and poorly processed, it has practically no value at all expect for the mineral content." (Kehl-East Central)

### 2130-A8, B2, E2

### EFFECT OF EFFLUENT FROM BEEF FEEDLOTS ON THE PHYSICAL AND CHEMICAL PROPERTIES OF SOIL

Department of Agronomy
Nebraska University
Lincoln
D. G. Hinrichs, A. P. Mazurak, and N. P. Swanson.
Soil Science Society of America Proceedings, Vol. 38, No. 4, p. 661-663, July-August, 1974. 5 tab, 11 ref.

Descriptors: *Feedlots, *Cattle, *Effluent, *Soils, *Physical properties, *Chemical properties, Nebraska.

As feeding operations have increased, the problems of waste management, disposal and utilization have multiplied. The disposal of solid and liquid wastes has become an important pollution problem with the increase in feedlot size. This field study's main objective was to determine the effects of effluent applications on soil physical properties. Beef feedlot effluent was applied as irrigation over a 2-year period to a Colo silty clay loam soil in Eastern Nebraska. Atlas sorghum (Sorghum bicolor L. (Moench)) was used as the crop in 1971 and 1972. The weekly irrigation applied during the growing season ranged from 0- to 5.0 cm. of water or effluent. No statistically significant difference in soil bulk density, water-retention charactersitics, or size distribution of particles and water-stable aggregates was produced by effluent applications. However, significant differences were measured in the hydraulic conductivities of disturbed soil samples. Also soil permeability was reduced. An increase in the electrical conductivities and Na+, K+ and C— in the leachates obtained from hydraulic conductivity determinations for the effluent-treated plots was noted during the growing season. Leaching from winter rains, however, essentially eliminated these increases except for K+ which was greatly reduced. (Kehl-East Central)

### 2131-A8, C2, E2

### THE EFFECT OF LARGE APPLICATIONS OF MANURE ON MOVEMENT OF NITRATE AND CARBON IN AN IRRIGATED DESERT SOIL

Imperial Valley Conservation Research Center
Brawley, California
B. D. Meek, A. J. MacKenzie, T. J. Donovan, and W, F. Spencer.
Journal of Environmental Quality, Vol. 3, No. 3, p. 253-258, July-September 1974. 9 fig, 3 tab, 8 ref.

Descriptors: *Nitrates, *Carbon, *Movement, Leaching, Irrigation.
Identifiers: *Land disposal, *Application rates, *Desert soil, Crop growth.

The large number of cattle concentrated in feedyards has caused manure disposal to become a serious problem. Application of manure at high rates on agricultural land is a practical solution and is the most inexpensive disposal means. This study's objective was the evaluation of the movement of Mn, nitrate and soluable organic carbon after application of varying manure rates and irrigation schedules. The amount of soluble organic carbon in the soil solution was greatly increased by manure application. Along with restricted oxygen movement from the atmosphere, the organic carbon energy source moved to the 80-cm. depth causing reducing conditions, solution of manganese, and reduction of nitrate. When manure was applied only 1 year, leaching of nitrate occurred to a depth of 80-cm during the next year because of less extreme reducing conditions. These results indicate that it should be possible to adjust irrigation schedules and manure application rates for fine-textured soils in desert regions so that very little nitrate would be leached below the root zone. To do this and achieve good crop growth, adjustment of the two factors would be necessary so that the surface soil is aerobic while a reducing zone is present in the subsoil. (Kehl-East Central)

### 2132-A1,A2,A3,A4,A5,A7,B2,B3,D1,D2,D3,E2,E3,F1,F2

### AGRICULTURAL WASTE MANAGEMENT: PROBLEMS, PROCESSES AND APPROACHES

Department of Agricultural Engineering
Cornell University
Ithaca, New York
R. C. Loehr
New York Academic Press, 1974, 576 p. 121 fig, 101 tab, 667 ref.

Descriptors: *Waste disposal, Legal aspects, Agricultural runoff, Lagoons, Ponds, Aerobic treatment, Anaerobic conditions, Economics, Water pollution, Air pollution, Livestock, Dusts, Gases, Bacteria, Drying, Methane, Sewage, Fertilizers, Nitrogen.
Identifiers: *Agricultural wastes, *Waste management, Land disposal, Processing, Biological processes, Composting, Animal wastes, Food processing wastes.

This book underscores the magnitude of the agricultural waste problem and points out the alternative methods of handling and treating agricultural wastes. Methods integrating engineering and scientific fundamentals are applied to the development of sound agricultural waste management systems. Aspects of the problem discussed are: (1) the legal and social constraints of pollution control, (2) changing practices in agriculture, (3) environmental impact of all wastes related to agriculture and the characteristics of their wastes. Fundamentals and processes discussed are (1) biological processes, (2) ponds and lagoons, (3) aerobic treatment, (4) anaerobic treatment, (5) utilization of agricultural wastes, (6) land disposal of wastes, (7) nitrogen control and (8) physical and chemical treatments. Management approaches to help establish a balance between agricultural production, profit, and environmental quality are also discussed. (Battles-East Central)

### 2133-A3, A4, A5, A8, B1, C2, E2

### ANIMAL WASTE UTILIZATION FOR POLLUTION ABATEMENT — TECHNOLOGY AND ECONOMICS, PHASE I

Agricultural Engineering Department, Nebraska University, Lincoln.
O. E. Cross
OWRR Project Completion Report, Nebraska Water Resources Research Institute, Lincoln, June, 1971, 34 p. 7 fig, 13 tab, 2 ref.

Descriptors: *Water pollution, *Sources, *Farm wastes, *Pollution abatement, *Irrigation water, Water utilization, Crop response, Soils, Waste disposal, Sodium, Potassium, Electrical conductance, Waste disposal, Nitrates.

The pollutional potential of the surface runoff water was based upon the following factors: nitrate nitrogen, sodium, potassium, and electrical conductance. Based upon these four factors, this study indicates that high manure applications to cultivated soils will cause pollution of surface runoff water only during the first fifteen minutes of the first runoff event. Although "polluted," the concentration of pollutants in this runoff water is below the limits set for irrigation water. Hence, all runoff should be recycled for irrigation uses only. After one year of heavy manure application, the underground water (static level at 47 feet below grade) retains potable quality. Indications are that repeated annual application of heavy rates of manure on land will lead to deterioration of the physical properties of soil, owing to the large amounts of sodium and potassium in manure. Also, feeding large quantities of sodium and potassium beyond the minimum requirement for the animals should be avoided. Irrigation techniques indicate: (1) the initial intake of water into the soil increases as higher manure loadings are applied, (2) the basic intake rate is higher on areas plowed 8 inches deep, and (3) the basic intake rate on any specific manure loaded area increases with time elapsed from date of manure application. (Cross-Nebraska University)

### 2134-B3, C1, D1, D2

### DRYING CHARACTERISTICS OF FORMED POULTRY EXCRETA

Application Engineer, Canning Machinery Division, FMC Corporation, Hoopeston, Illinois.
T. M. Midden, I. J. Ross, H. E. Hamilton, J. J. Begin.
Transactions of the ASAE, Vol. 16, No. 2, p. 331-333, March-April, 1973. 5 fig. 2 tab, 4 ref.
Descriptors: *Poultry, *Drying, *Physical properties.
Identifiers: *Excreta, Crust, Cylinders, Drying techniques.

Poultry manure as excreted is a high-moisture content semi-solid slurry with no definite geometric shape. There are no void spaces within the mass through which drying air can be forced. Manures could be dried by conventional deep bed drying techniques such as those used to dry small grains if they could be formed into regular shapes and made to retain these shapes in a stack. It is possible to extrude a cylinder of manure, cut it into short lengths, expose it to high temperature drying air to form a crust, and complete the drying in a deep bed drier. Research was performed to deal with (1) the determination of thin layer drying constants as affected by drying air temperature and cylinder diameter and (2) the determination of the hardness of the crust formed around a pellet of manure when exposed to varying drying air temperatures for different periods of time. A discussion is given on the experimental results of this study. (Cameron-East Central)

### 2135-A1, B1, B4, C1, C2, E2, F1, F2

### AGRICULTURAL WASTE CONFERENCE

Michigan State University
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, Michigan, May 22-23, 1974, 211 p.

Descriptors: *Animal wastes, *Design, *Michigan, *Recycling, Chemical properties, Physical properties, Odor, Economics, Feedlots, Confinement pens, Dairy industry, Permits, Nutrients, Legal aspects.
Identifiers: *Waste management, Housing, Land disposal.

A conference was held at Michigan State University to discuss animal waste management and utilization. The two day program included: (1) a tour of active research projects, demonstrations and facilities focusing on animal and municipal wastes. Brief summaries of the research projects are included in the proceedings; (2) an evening discussion period featuring 5 to 8 minute slide presentations of waste handling systems and equipment by design engineers and company representatives; (3) a full day of papers on topics selected by the conference planning committee. (Cartmell-EastCentral)

### 2136-A2, B2, B3, B4, E2

### ANIMAL WASTE SYSTEMS

Extension Agricultural Engineer
Michigan State University
T. L. Loudon and L. R. Prewitt
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974. p. 1-10, 6 fig, 1 tab.

Descriptors: *Feedlots, *Confinement pens, *Michigan, Waste storage.
Identifiers: *Waste management, *Open lots, Partially covered lots, Stanchion dairy barn, Runoff control, Flushing systems, Slotted floors, Land disposal.

The components of waste management systems for six types of confinement housing were discussed. The components include collection, storage, and land disposal of manure as well as runoff control systems for outside lots. Collection may be by mechanical scraping or manure may may collect in a pack where deposited or be worked through slotted floors. Storage structure design and manure consistency will determine whether the material must be handled as a liquid or a solid when emptying stored wastes. Land disposal rates should be based on the nutrient content of the waste and this can change during storage, particularly in the case of nitrogen. (Cartmell-East Central)

### 2137-A8, B1, B4

### PLANNING AND DESIGNING WASTE STORAGE SYSTEMS

Soil Conservation Service
Ann Arbor, Michigan
B. E. Boesch and P. W. Koch
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 11-19. 3 fig.

Descriptors: *Design, *Waste storage, *Confinement pens, Nutrients, Nitrogen.

Methods for coordinating storage unit design with livestock operations, cropping systems, and the characteristics of the cropland soils on the farm are presented. Improper storage or management of manure can be a source of serious pollution lakes and streams. It is necessary to design and manage a storage system that will reduce the loss of plant nutrients from the manure, prevent compaction of cropland soils by equipment during wet periods, provide better use of labor through mechanization of manure handling, reduce mud problems around livestock enterprises, and provide for the application of manure when crops can best use the nutrients. There is no single best method for waste collection and storage. Topography soil type, space limitations, economics, location, etc. all influence the method chosen. The entire livestock enterprise must be considered in planning waste management design. The type and design of storage units must recognize the nature of foundation (soil) materials on the site. Provision must be made for management of all water at the site as well as manure. Specific computations are given for various storage systems. (Cartmell-East Central)

### 2138-A6, B2, B3, B4, C1, C2, D3

### COMPOSITION OF WASTE AS EXCRETED, CHANGES DURING STORAGE, AND ODOR DEVELOPMENT

Department of Agricultural Engineering
Michigan State University
J. B. Gerrish
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 21-24, 4 fig, 3 ref.

Descriptors: *Chemical properties, *Physical properties, *Waste storage, *Odor, Moisture content, Confinement pens, Ammonia, Nitrogen.
Identifiers: *Coprophage.

It is very difficult to distinguish between manure storage and manure treatment since during storage some kind of biological activity usually takes place. This biological activity changes the form of the manure and its odors. Coprophage is defined as "to eat waste." One of the most important conditions for coprophage is the moisture content on the manure. Odors are more serious for wet storage systems than for dry ones. Some chemical compounds which have been identified in the air from the anaerobic decomposition of livestock and poultry manures are listed. Odorous compounds are also identified for the atmosphere of a beef cattle confinement chamber under three manure handling programs: clean and wash daily, shovel out daily, and no cleaning. The list clearly indicates the advantage of daily cleaning. (Cartmell-East Central)

### 2139-A6, A7, B1, F2

### ODOR PROBLEMS ASSOCIATED WITH AGRICULTURAL WASTE HANDLING

Air Pollution Control Division
Department of Natural Resources
P. R. Shutt
Presented at Agricultural Waste Conference Emphasis - Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 25-29.

Descriptors: *Odor, *Michigan, *Air pollution, *Regulation, *Permits, Poultry, Cattle, Dairy industry.
Identifiers: *Waste handling, Swine.

The Air Pollution Control Commission is responsible for controlling air pollution in the state of Michigan. The Michigan Air Pollution Control rules require that a permit be obtained from the Commission prior to installation of facilities which could result in air pollution or prior to the installation of facilities meant to control air pollution. This is interpreted to include agricultural facilities as well as other industries. Michigan's main agricultural odor sources, poultry, swine, beef and dairy operations, have several factors in common—large concentrations of livestock in confined areas, problems with good housekeeping, and/or liquid waste handling systems. Thus isolation, good housekeeping methods, and good waste disposal methods and techniques are desirable. Specific procedures and recommendations are made for each of these four types of livestock operations. (Merryman-East Central).

### 2140-A2, A4, B2, E2, F1, F2

### ECONOMIC IMPACT OF SELECTED POLLUTION CONTROL MEASURES ON BEEF AND DAIRY FARMS

Agricultural Economist
Economic Research Service
U. S. Department of Agriculture
J. B. Johnson
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 31-43. 7 tab.

Descriptors: *Water pollution, *Regulation, *Permits, *Costs, Agricultural runoff, Feedlots, Dairy industry, Michigan.
Identifiers: *Effluent guidelines, Land disposal.

The U. S. Environmental Protection Agency point source effluent guidelines are described in detail as they pertain to beef and dairy operations. Even the smaller dairy and beef feedlots (under 1,000 animal unit capacity) may be expected to comply with effluent guidelines established by water pollution control agencies. Michigan and other states will have state administered, federally approved permit programs for point source dischargers. Feedlots and dairy farms with surface water control problems will receive permits for continued operation contingent on a specified time for taking corrective measures. The application of these effluent guidelines will have differential effects on capital outlay requirements and production costs, depending upon feedlot capacity or dairy herd size and the type of housing in use. (Cartmell-East Central)

### 2141-A4, A7, C1, C2

### MICHIGAN'S ENVIRONMENTAL CONTROL PROGRAM AND ORGANIZATION

Deputy Director, Environmental Protection Branch, Department of Natural Resources, Michigan
R. W. Purdy
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 45-50. 1 fig.

Descriptors: *Michigan, *Water pollution, *Air pollution, Eutrophication
Identifiers: *Environmental control

Data on Michigan streams shows that a large majority are not experiencing water quality problems. Approximately 85 stream segments have known or suspected water quality problems from point source discharge. About half of the state's lakes may be experiencing eutrophication. This is a natural aging process which can be accelerated by man's activities. Michigan estimates about one third of its lakes to be over-fertilized from unnatural sources. In general, it was concluded, the water resources of Michigan are in good condition. The air pollution problems in the areas other than highly populated metropolitan centers are basically caused by emmission of air contaminants from industrial operations. The major contaminants for which there is concern are sulfur dioxide and suspended particulate matter. (Cartmell-East Central)

### 2142-A4, B1, F2
### NPDES PERMIT SYSTEM AND GUIDELINES FOR MICHIGAN PRESENTED AT THE AGRICULTURAL WASTE CONFERENCE, MICHIGAN STATE UNIVERSITY

Regional Water Quality Administator, Bureau of Water Management, Michigan Department of Natural Resources
T. L. Kamppinen
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University. East Lansing. May 22-23, 1974, p. 67-69.

Descriptors: *Permits, *Water pollution control, *Feedlots, *Confinement pens, Livestock
Identifiers: *Discharges

October 18, 1972, Congress passed Act 92-500 known as the Federal Water Quality Act Amendments of 1972. This Act was passed over a presidential veto. Section 402 established the National Pollutant Discharge Elimination System Permit Program. The Act required all point source dischargers to obtain a NPDES Permit by not later than December, 1974. The guidelines defined the term feedlot as a confined animal or poultry growing operation where crop or forage growth or production is not sustained in the area of confinement. To be recognized as a feedlot, the feedlot must meet one of the following citeria: (a) 1000 slaughter steers and heifers, (b) 700 dairy cattle, (c) 2500 swine over 55 lbs., (d) 10,000 steers, (e) 55,000 turkeys, (f) 100,000 laying hens or broilers, (g) operations with unlimited continuous flow watering system, or (h) 1000 animal units from a combination of cattle, swine, or sheep. Michigan's requirements for filing of permit applications are discussed. (Cartmell-East Central)

### 2143-A1, B1, F1
### POLLUTION ABATEMENT ON FARMSTEADS

Agricultural Stabilization and Conservation Service
R. Locher
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 71

Descriptors: *Pollution abatement, *Costs, *Farms, *Government finance
Identifiers: *Cost-sharing

The Federal Government shares the cost with farmers under the 1974 Rural Environmental Conservation Program and the 1973 Rural Environmental Assistance Program for carrying out pollution abatement practices on farmland. Both conservation programs are available to farmland owners throughout the 1974 year. Requests for cost-sharing must be filed and approved by the local county ASC committee before the practice is stated. (Cartmell-East Central)

### 2144-B5, C2
### EFFECT OF HOUSING TYPE ON NUTRIENT COMPOSITION OF BEEF CATTLE MANURE

Department of Crop and Soil Sciences, Michigan State University
D. C. Adriano
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 73-84. 6 tab. 7 ref.

Descriptors: *Housing *Nutrients, *Chemical properties, *Nitrogen, *Phosphorus, *Potassium, *Salts, *Feedlots, Climate
Identifiers: *Manure

The primary objectives of this study were: (a) to characterize the chemical composition, with emphasis on nitrogen, phosphorus and potassium of old and fresh beef cattle manures, and (b) to evaluate the nitrate and salt status of farms receiving these manures. The nutrient concentrations in manures were found to be related to the degree and duration of manure exposure to climate. Thus manures from open-lot housing systems were found to have the lowest nitrogen and phosphorus concentrations. The most favorable evaporative conditions, present in open-lots, caused the lowest nitrogen concentration. (Carmell-East Central)

### 2145-A8, C2, E2
### UTILIZING THE NUTRIENTS IN ANIMAL MANURES

Department of Crop and Soil Sciences, Michigan State University
L. W. Jacobs
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, p. 85-100. 3 fig. 5 tab. 10 ref.

Descriptors: *Animal waste, *Soils, *Chemical properties, *Physical properties, Nutrients.
Identifiers: Plant-soil environment, Land disposal, Application rates

A plant nutrient can be used by a crop, become part of the soil complex, leach down through the soil profile within drainage water, be washed away by runoff and erosion, and/or volatilize and be lost as a gas. To consider the various plant nutrients in view of these five factors, the text included discussions of some physical and chemical properties, the chemistry of nutrients in soils, and the problems encountered in maximizing the rates of manure applications. It was concluded that the most practical method of animal manure disposal is application to soils, The soil-plant environment provides the best means for utilizing the potential value of manures. But like any other resources, the soil-plant environment must be properly managed to be the most effective. (Cartmell-East Central)

### 2146-B1, D1, F2
### LICENSING CONCERNS FOR THE TRANSPORATION OF ANIMAL WASTES

Chief, Solid Waste Management Division, Environmental Protection Branch
F. B. Kellow
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 101-103.

Descriptors: *Animal wastes, *Transportation, *Regulations *Waste management, *Licensing, Spillage, Pollution control

Today the transportation of waste is not without the lack of equipment. There are now special roll-off containers, portable and stationary compaction units that will increase by at least 3 times the quantity of material that can be moved in a 40-cubic yard container. Collection vehicles can now grind their waste prior to compaction to increase the load capacity. Large scale animal production facilites must be considered as industries and therefore be under the environmental controls instituted for the protection of the people. This would require the licensing and control of the transportation vehicles used to transport animal wastes along the highway for any operation providing products for more than the immediate farm family. The requirements set up for the proposed licensing of these transportation vehicles are briefly discussed. (Cartmell-East Central)

### 2147-B2, E2, F2
### PENDING LEGISLATION RELATED TO AGRICULTURAL WASTE

Michigan Department of Agriculture
D. R. Isleib
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 105.

Descriptors: *Michigan, *Legislation, *Waste water disposal *Land disposal

With regard to pending legislation, two bills are briefly described. Bill HB 4614 provides for regulation of toxic substance applications to land used or intended for use for agriculture by the Michigan Department of Agriculture. SB 1245, would establish local and state control over waste water disposal programs by the Corps of Engineers. It would require that both local government and the legislature approve plans for waste water disposal on land. (Cartmell-East Central)

### 2148-A4, A12
### ANIMAL WASTE IMPACT ON RECREATION WATERS

Water Quality Appraisal Section, Michigan Department of Natural Resources
R. Waybrant
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 107-108.

Descriptors: *Animal wastes, *Water pollution, *Recreation

The impact of animal waste on the quality of recreational surface waters will depend upon the constituents of the animal waste and the character of the receiving water. The general recreational aspects including swimming, fishing, and boating, are considered in this presentation along with the known changes or impact that individual constituents of animal waste will cause in a given situation. (Cartmell-East Central)

### 2149-A1, A2, A3, A6, B1, F1
### ACCEPTABLE SOLUTIONS TO POTENTIAL WASTE POLLUTION SITUATIONS

Department of Agricultural Engineering, Michigan State University
R. L. Maddex, T. L. Thorburn, C. Harvey, P. Koch, and P. Shutt
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 109-133. 8 fig.

Descriptors: *Livestock, *Poultry, Odor, Agricultural runoff, Ccsts
Identifiers: *Pollution abatement, Waste handling

Six examples of livestock and poultry facilities were selected for discussion by the panel. Suggested pollution prevention or abatement practices were recommended. Overlays of each example and the recommended waste handling systems were prepared and projected on the screen for presentation and discussion. A brief summary of the discussion is included. (Cartmell-East Central)

## 2150-A6, A11, B2, D1, D3, E3, F1

### FLUSHING SWINE WASTE

Department of Animal Husbandry, Michigan State University
E. C. Miller
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, May 22-23, 1974, p. 133-134.

Descriptors: *Aeration, *Recycling, Odor, Costs
Identifiers: *Swine, *Flushing, Slotted floors, Pits

A flushing system was installed at a Michigan State University swine research farm. Experience has shown that the flushing trench under a slotted floor should have a minimum of 2 percent slope. The surface of the trench should be troweled as smooth as possible and a good urine resistant concrete sealor applied. Experiments are in progress involving the aeration of the waste by a new mechanical device for forcing oxygen into the liquid under pressure. The aerated material is then recycled to be used as the sole source of drinking water and for reflushing. The performance of the pigs has not been consistently good but the results indicate that the feeding of recycled waste has a definite potential. (Cartmell-East Central)

## 2151-A6,B2,C2,D2,D3,E3

### AGRICULTURAL POLLUTION CONTROL LABORATORY

Agricultural Engineering Department, Michigan State University
J. B. Gerrish
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, Michigan, May 22-23, 1974, p. 137.

Descriptors: *Bacteria, *Hydrogen sulfide, Methane, Odor, Lagoon, Wastewater
Identifiers: Swine, Anaerobic conditions, Purple sulfur bacteria

A project is underway to mass-cultivate purple sulfur bacteria. These photosynthetic bacteria have the ability to consume hydrogen sulfide under anaerobic conditions. Hydrogen sulfide is probably the most obnoxious component of odor coming from a wastewater lagoon. Another project involves methane production from hog manure. There are two facets of methane that will be investigated: the removal of hydrogen sulfide from the gas and matching gas production with energy utilization. (Cartmell-East Central)

## 2152-B3, C1, D1, D2

### HANDLING, DEHYDRATION AND UTILIZATION OF POULTRY WASTES

Department of Poultry Science, Michigan State University, East Lansing
J. C. Zindel
Agricultural Waste Conference Emphasis-Animal Waste, Kellogg Center, Michigan State University, East Lansing, Michigan, May 22-23, p. 145-146.

Descriptors: *Dehydration, *Poultry, Recycling, *Design data, Demonstration project, Construction, Laying house, Waste removal, Excreta

A demonstration project was undertaken to design, construct and test a poultry laying house that would incorporate a complete system for waste removal and dehydration of the excreta. The excreta was removed daily and placed in a drying tunnel. The exhaust air from the ventilation system was directed over the excreta for approximately 24 hours in the drying tunnel before machine dehydration. Fresh excreta was voided at 80 percent moisture. Average moisture content of excreta when placed in the tunnel and also just prior to machine dehydration varied with the ventilation rate. (Cartmell-East Central)

## 2153-A4, A5, A6, B1, B4, D2, D3, E2, E3, F1

### NATIONAL SYMPOSIUM ON POULTRY INDUSTRY WASTE MANAGEMENT

Nebraska University
National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963.

Descriptors: *Poultry, *Waste treatment, *Waste storage, *Waste disposal, Odor, Costs, Design, Water pollution
Identifiers: *Pollution

A national symposium on poultry industry waste management was held at Nebraska University with the primary purpose of learning as much as possible about the problems of poultry waste management. Among topics considered were: sanitary landfills, lagoons, dehydration, incineration, odor, water pollution, recycling, land disposal, and refeeding. Symposium participants attempted to discuss and identify waste disposal methods that were economically feasible, mechanically possible, and socially acceptable. (Cartmell-East Central)

## 2154-A6, A10, B2, B3, D1,

### WASTE MANAGEMENT PROBLEMS ON THE FARM

Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 5 p.
C. E. Ostrander

Descriptors: *Poultry, Spreading, Spraying, Hydraulic collection, Odor, Climates
Identifiers: *Waste management, Flies

The waste problem is not one of merely removing the manure physically, but includes eliminating odors and finding a way actually to dispose of this material in a sanitary manner. Engineers have shown that we are producing 278,000,000 pounds of poultry manure every day. In some areas where the climate is not dry enough to dry the droppings under the cages, poultry producers dry the wastes in yards by thin spreading. Still others liquefy the droppings by making a slurry and then thin spread it layer by layer by spraying. This allows accumulation over a period of several months without fly development. In warm climates and where open houses are used, flies can be a major problem. Flies have not been as much of a problem in closed houses. Odors are a problem with closed houses and cool climates. Odors are a major reason for the rapid development of hydraulic collection in many areas. Besides holding down odors, the hydraulic system gives the poultryman more flexibility in spreading or disposal. There are odors from the hydraulic system when cleaning, but cleaning is less frequent. Disposal of dead birds is another problem that needs attention. (Cartmell-East Central)

## 2155-A6, A10, B3, C1, C3, D1

### FOWL FECAL FACTS

S. A. Hart
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 13 p. 9 fig. 4 tab, 10 ref.

Descriptors: *Poultry, *Physical properties, *Chemical properties, Biochemical oxygen demand, Moisture content, Nutrients, Odor, Organic matter, Drying
Identifiers: *Excreta

Poultry manure is voided as a single product; kidney excretions are combined with the feces. The amount of solids defecated per day depends upon the quantity and quality of the feed ingested, and upon the efficiency of metabolism. Chicken manure has a specific gravity of approximately 1.75. The solids in manure are of two kinds—organic (usually called volatile solids) and inert (referred to as ash). What really makes manure a problem is its biological properties. Chicken or turkey manure contains a great deal of organic matter readily useable by lower life forms. Manure nourishes billions of microorganisms, and can serve as a food source for fly larvae. The standard measure of stability or putrescibility of wastes, including manure, is biochemical oxygen demand (BOD). Chicken excrement amounts to 0.015 lb. BOD hen-day. To the farmer or health authority, the most important biological characteristic of poultry manure is its capacity to culture fly larvae. Manure is a prime breeding medium for flies because it consists of moist nutritious organic matter. Drying is one way of greatly reducing the attractiveness of manure to flies. (Cartmell-East Central)

## 2156-A1, B2, C1, C2, C3, D3, E1

### MANURE DISPOSAL LAGOONS

H. J. Eby
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 18 p. 4 tab. 38 ref.

Descriptors: *Lagoons, *Waste treatment, *Waste disposal, *Chemical properties, *Physical properties, Biological properties, Site selection.
Identifiers: Loading rates

The physical, chemical and biological aspects of the functioning of a manure lagoon are presented. Situations wherein a lagoon is not practical and factors influencing lagoon sites are given. A biological waste treatment process is limited in efficiency by the capabilities of the biological population. The important physical factors affecting the population of a stabilization pond are temperature, light, specific gravity and hydrostatic pressure. The specific gravity of an organiism present in the stabilization pond will determine whether the organisms will have a tendency to float, remain suspended or settle. The important chemical factor in a stabilization pond environment are the nutritional effects, the pH effects, and the toxic effects. The important biological factors in an environment are the inter-relationships of species. Although not a cure-all for manure disposal, where conditions are tight and where proper management is practiced, a lagoon can be a satisfactory means of manure disposal. (Cartmell-East Central)

## 2157-A6, A10, A11, B2, C2, D3

### INDOOR LAGOONS FOR POULTRY MANURE DISPOSAL

Nebraska University
J. L. Adams
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 16 p. 7 tab.

Descriptors: *Lagoons, Poultry, *Waste disposal, Odor, Performance, Nitrogen, Ventilation, Design
Identifiers: *Slat floors, Flies

Based on experiments with microlagoons placed under poultry cages, it appears that cubage is the primary consideration in predicting the interval of time between cleanouts. Under the conditions of the experiment, there were no beneficial effects of heating the tanks. The reaction of both the slat floor indoor lagoon and the "microlagoons" tended to range from slightly acid to slightly alkaline with the mean pH being 7.5 for the 20 week microlagoon experiments. The large amount of water (315 cu. ft. per bird) afforded a reservoir of heat which was useful in leveling out quick decline in temperature. Aeration produced no beneficial effect on bacterial digestion. After one year of operation, the dried contents of the slat floor lagoon contained about 2.5%. nitrogen. The odors produced by the slat floor house during 23 months of operation did not reach an intensity objectionable to caretakers or visitors and were not detrimental to performance of the birds. Odor and taste panels evaluated eggs left in the lagoon house for 36 hours. Off odors could only be detected on dirty eggs and this was true of both slat floor, lagoon and litter houses. Washing the dirty eggs removed the odors. No odors were detected in any eggs after shells were removed, whether raw or cooked.

## 2158-B3, B5, D3, F1

### DIGESTION OF FARM POULTRY WASTES

E. P. Taiganides
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 14 p. 3 fig. 10 ref.

Descriptors: *Anaerobic digestion, *Poultry, *Waste treatment, *Sludge digestion, *Design, Costs, Fertilizers, Gases
Identifiers: Loading rates

The anaerobic digestion process as a method of treating poultry wastes is discussed. One method of treatment of concentrated organic wastes that has been found satisfactory in municipal and industrial wastes is the process of sludge digestion. Sludge digestion is a biological process during which the organic matter is decomposed by anaerobic bacterial organisms. The anaerobic digestion process differs in many respects from other types of fermentations. The most important difference is that it is neither necessary to use a pure culture of bacteria nor to maintain such a culture for innoculation or reinnoculation. The quality and quantity of gas produced and the rate of decomposition are affected by temperature, the loading rate and the solids concentration of the waste fed to the digester; the accessibility of the substrate; the detention period; and the concentration of volatile acids in the digester. The main advantages, design considerations and cost figures based on manufactured sludge digestion equipment for different size digesters are presented and discussed briefly. (Cartmell-East Central)

## 2159-A6, A10, B2, B4, E2

### PROGRESS REPORT ON MANURE HARVESTING

H. R. Davis and A. T. Sobel
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 14 p. 11 fig.

Descriptors: *Poultry, *Liquid wastes, Waste Storage
Identifiers: *Waste handling, *Semi-liquid wastes, Transporting, Field spreading

The difference between liquid and semi-liquid waste handling systems for poultry droppings is discussed. Specific methods and equipment are described for handling wastes utilizing caged, slatted, and tiered systems for raising poultry. The transition from a semi-liquid to a liquid system is a natural alternative due to reduction of flies, odors, and repetitive labor requirements. Methods for removing manure to the spreading device, transporting device, or storage are described. Handling the manure in a semi-liquid form requires some device similar to a conventional barn cleaner. For manure in liquid form, the use of pumps is practical. Augers and open troughs have been used to move both semi-liquid materials and liquid materials, using faster speeds for the latter. Liquid manure can be moved into storage by gravity or by a combination of gravity and flushing. The type of handling system used determines the method used for field spreading or the transporting of manure. When in a semi-liquid form, conventional spreaders can generally be used. Liquid spreading requires a different type of spreader. A side delivery type has the advantage of working for all forms of manure, whether semi-liquid or liquid. (Cartmell-East Central)

## 2160-A6, A7, B3, C1, C2, D2, E3

### DEHYDRATION AND INCINERATION OF POULTRY MANURE

Department of Agricultural Engineering, Cornell University
D. C. Ludington
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 15 p. 5 fig.

Descriptors: *Dehydration, *Incineration, *Poultry, *Equipment, *Costs

Two possible methods of disposal of poultry manure are dehydration and incineration. Dehydration is one method of changing the physical properties of poultry manure so that it is no longer offensive and still retains much of its original nutritive value. The major problems are odor and dust conditions in and around the dehydration point. For analysis of the costs involved in dehydrating poultry manure, a hypothetical processing plant was designed and studied. Because of the uncertainty of a market for pelleted manure and the high cost of fuel for dehydration, incineration of the manure was investigated. In this way the heat of combustion of the manure could be used to reduce the fuel costs. In order to analyze the process of incineration, many of the physical, chemical and thermal properties of the manure had to be known. A research project was initiated to ascertain these properties. If a mechanical dewatering device could remove the free water, incineration might be the most economical method of disposal. Dehydration cannot be economical unless the product can be sold for at least $30 per ton. (Cartmell-East Central)

## 2161-C2, E2, F1

### AGRICULTURAL VALUE OF POULTRY MANURE

R. S. Dyal
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 15 p. 7 tab, 22 ref.

Descriptors: *Poultry, *Organic matter, *Costs, *Fertilizers, Nutrients, Nitrogen
Identifiers: *Land spreading

The purpose of this paper is to estimate the supply of manure from laying hens, broilers, and turkeys; summarize data on its plant nutrient and organic matter contents; and discuss its value as a fertilizer and for soil improvement. About 33.4 million tons of manure from laying hens, broilers, and turkeys was voided in 1960. Poultry manure is generally higher in plant nutrients, particularly nitrogen, than other farm manures. With the factors of availability taken into consideration, the value of plant nutrients contained in manure from broilers, laying hens, and turkeys voided in different litters varied from $3.15 to $16.40. The most profitable method of manure disposal is spreading accumulations of solid manures on cropland, especially where land is available. (Cartmell-East Central)

## 2162-A3, A4, A5, C2, C3, E2

### WATER POLLUTION PREVENTION

T. L. Willrich
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 8 p. 20 ref.

Descriptors: *Water pollution, *Groundwater, Livestock, Poultry Agricultural runoff, Nitrates, Microorganisms, Percolation, Pathogenic bacteria

Disposal of livestock and poultry wastes onto or below the ground surface presents a potential source of surface and ground water pollution. Either a high coliform bacteria or nitrate test result indicates an existing or a potentially hazardous water supply for domestic use. Many individual well water supplies test unsafe for human consumption. Nature is the best ally in water pollution prevention. Many microorganisms fail to reproduce and survive outside of their natural habitat, the body of an animal. Most pathogens are believed to die rapidly in ground water. Nitrates appear to be one of the more serious chemical pollutants resulting from the biological decomposition of animal wastes. Nitrate poisoning appears to be confined to infants during their first few months of life. The specific source of nitrates causing pollution in a particular well may be difficult to positively identify. Water percolating through the soil carries nitrates with it. Pollution prevention can be accomplished best by assisting natural purification processes. In spreading wastes, thin, dilute, expose to sun and oxygen or other destructive environmental conditions, and filter slowly. (Cartmell-East Central)

## 2163-A4, A5, A6, A10, A12, A13, B1

### PUBLIC HEALTH ASPECTS OF POULTRY WASTE MANAGEMENT

R. J. Black
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 3 p. 1 ref.

Descriptors: *Public health, *Poultry, Costs, Dusts, Aesthetics
Identifiers: *Waste management, Flies, Noise

Each segment of the poultry industry—including hatcheries, broiler ranches, egg ranches, and processing plants — produce different types of wastes which create a variety of problems. From the public health standpoint, these problems frequently result in complaints from nearby residents concerning odors, fly production, water pollution, dust, noise, rodent attraction, and aesthetics. Another problem that has concerned the poultry industry and public health workers is salmonellosis. Continued infection of flocks is costly to the poultryman and carries over to the product. (Cartmell-East Central)

## 2164-A10, B3, E2, F1

### SANITARY LANDFILLING OF POULTRY WASTES

Division of Environmental Engineering & Food Protection, Public Health Service, U. S. Department of Health, Education & Welfare, Washington, 25, D. C.
R. J. Black
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 5 p. 5 ref.

Descriptors: *Poultry, *Landfills, *Solid wastes, Costs
Identifiers: *Manure, *Sanitary landfill operations, Hauling distances, Flies

There are two types of sanitary landfill operations of interest to the poultry industry in disposing of such poultry wastes as manure, feathers, litter, carcasses, and offal. They are (1) the public sanitary landfills that are operated for the disposal of refuse and other solid wastes, and (2) the sanitary landfills that are operated for only the disposal of poultry wastes. Costs of operation, types of wastes accepted, methods of financing, and user charges vary widely, so that local conditions and hauling distances must be investigated to determine the feasibility of utilizing sanitary landfill facilities for the disposal of poultry wastes. There are two phases of fly control work that are important in the operation of sanitary landfills: (1) preventing further oviposition, and (2) preventing fly emergence. Laboratory tests have shown that no reasonable amount of uncompacted cover would prevent fly emergence, since houseflies emerge through five feet of uncompected earth cover. Field tests have shown that under usual field conditions, a 6-inch layer of compacted cover prevented fly emergence. (Cartmell-East Central)

## 2165-B3, B4, C1, C2, D3

### UTILIZATION AND DISPOSAL OF POULTRY MANURE

J. S. Wiley
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 12 p. 13 ref.

Descriptors: *Poultry, *Waste disposal, Aeration, Moisture content, Nutrients, Decomposition
Identifiers: *Composting

Farming and agricultural industry have expanded in the sense that individual installations have become larger while smaller establishments have been relinquished or consolidated. With this expansion has come the increasing problem of waste management. One method of handling wastes while they must be stored is by composting. Present-day composting is the aerobic, thermophilic decomposition of organic wastes to a relatively stable humus. Decomposition is done by the biological activity of microorganisms which exist in the wastes. A wide variety of organic wastes may be treated by composting but the raw mixture must meet certain requirements and the undertaking requires a certain amount of "know-how" and attention. Adequate aeration means the provision of enough air so that there will be some excess of oxygen to provide aerobic conditions at all times throughout the mass. Proper moisture content has perhaps the top rating of all criteria for optimum composting. A reasonable range of nutrients is necessary for both plant and microbial life to thrive and produce. The easiest of chicken manures to handle is the deep litter manure from ranches where the birds are on the floor. (Cartmell-East Central)

## 2166-A6, A7, D1, D2

### ODORS AND AIR POLLUTION

C. V. Wright
Presented at National Symposium on Poultry Industry Waste Management, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, May 13-15, 1963, 5 p.

Descriptors: *Wastes, *Poultry, *Air pollution, *Odor
Identifiers: *Odor control, *Odor detection, Chicken wastes

For purposes of air pollution control, odors may be classified into two broad categories: source and ambient odors. Source odors are those at their point of origin; ambient odors are distributed into the general atmosphere by air currents. The characteristics of greatest concern for odor control are the quality, strength, and occurrence of an odor or odors. The human organoleptic system must be used as the basic tool for odor detection and classification. No mechanical devices have been developed for this purpose as yet. Control of odors generally must be designed either to counter the cause, or to treat the emissions. Most odors are gaseous emissions and there are five proven methods for treating these types of odors. These are: combustion, absorption, adsorption, masking, and counteraction. The problems and recommendations from several plants processing feathers and other chicken waste products are given. (Cartmell-East Central)

## 2167-A2, B1, B4, F1

### PLANNING FEEDLOT WASTE DISPOSAL

Anonymous
Wallaces Farmer, Vol. 97, No. 22, p. 86, January 1972,

Descriptors: *Planning, *Feedlots, *Waste disposal, *Waste storage, *Design, *Costs, *Locating
Identifiers: *Soil Conservation Service, *Runoff, Livestock operations, Technical assistance

When a farmer builds a feedlot or any type of livestock facility, he must be certain it's not going to cause a pollution problem. Usually the farmer will work with the Soil Conservation Service (SCS) in planning to build these new facilities. The SCS has long been involved in conservation projects like terracing, long-term seedings, and tilling. It is now playing a big role in planning and designing feedlot runoff controls and waste storage systems for livestock operations. According to the state conservation engineer for SCS, there are two ways a farmer can get help from the SCS. A farmer can sign a cooperative agreement with his soil conservation district. Or he may apply directly to his ASCS Committee for cost share benefits and be referred to the SCS. In both cases the SCS can provide technical assistance in planning and locating feedlot runoff facilities and waste storage areas. Once the facility is built, an SCS representative checks the work, then submits final approval to the ASCS and cost share payment is made. (Cameron-East Central)

## 2168-D2, E3, F1

### THERMOCHEMICAL EVALUATION OF ANIMAL WASTE CONVERSION PROCESSES

Chemical Engineering Department, Texas Tech University, Lubbock
J. E. Halligan and R. M. Sweazy
Presented at 72nd National Meeting, American Institute of Chemical Engineers, St. Louis, Missouri, May 21-24, 21 p. 3 fig, 5 ref.

Descriptors: *Recycling, *Gases, *Oil, *Cattle, *Economics, *Feasibility studies
Identifiers: *Thermochemical evaluation

On a dry basis, cattle manure has a heat content of 4000 to 7500 Btu/lb. That of coal is 12,500. Thermochemical calculations for conversion of manure to methane gas, oil, and synthesis gas are detailed. On the basis of a manure output of seven pounds of manure (dry) per day from 600,000 cattle, all product streams would have values which total about $9000 a day. The cattle population (600,000) chosen is that within fifteen miles of a point near Hereford, Texas. Methane gas production would require oxygen costing $4276 per day on the basis of the authors' price assumptions. "As gas prices increase, this process may become feasible at some locations. A considerable amount of further development would be required to make oil production—which requires 380° C temperatures and 6000 psig pressures—economically feasible. "The production of synthesis gas suitable for feed to an ammonia plant appears to have the most promise at this time due to the simplicity of the process and the value of the product." (Whetstone, Parker, and Wells-Texas Tech)

## 2169-A6, A7, A9, A10, A12, B1, D1, D2, D3

### AGRICULTURAL SANITATION OF LIVESTOCK MANURES FOR CONTROL OF FLIES, ODORS, AND DUSTS

Department of Entomology, California University, Davis, 95696
E. C. Loomis
Journal of Milk and Food Technology, Vol. 36, No. 1, p. 57-63, 1973. 2 tab, 16 ref.

Descriptors: *Livestock, *Feedlots, *Dairy industry, *Flies, *Odor, *Dusts, Economics, Insecticides, Deodorants, Sprinkling
Identifiers: *Pollution control, *Waste management

The co-existence of agriculture and suburbia has brought the problems of flies, odor, and dust under close scrutiny. Because wastes (sewage, livestock wastes, and domestic wastes) are produced in such vast quantities and because flies, odors, and dusts resulting from agricultural activities are a matter of public health concern, cooperative research programs have been made involving interdisciplinary personnel representing federal, state, and local agencies in line with state and local codes and ordinances governing control of fly, odor, and dust problems. The most commonly accepted method of fly control has been the use of insecticides and adulticides. But flies have developed a resistence to many of these, thus causing stronger chemicals to be used. Agricultural people have had to turn to better manure management practices to supplement insecticide use. Dust problems have been fought by such methods as sprinkling of oil products, application of wood shavings, and sprinkling with water. Odor has been fought through use of deodorants, enclosed confinement, and better management practices. Thus, physical, mechanical, biological and chemical methods may be combined to beat these problems, but one big problem still remains—money. Livestock owners must find a way to defray the costs of implementing these pollution control measures. (Merryman-East Central)

## 2170-B1, D1, D3, F6

### DIFFUSION OF CATTLE MANURE SOLUTION THROUGH A WET POROUS STRATUM WITH REACTION

S. K. Choi, L. T. Fan, L. E. Erickson, and R. I. Lipper
Water Air Soil Pollution, Vol. 1, No. 4, p. 390-404, 1972.

Descriptors: *Diffusion, *Cattle, *Mathematical models, *Chemical oxygen demand, Porous media, Water pollution sources
Identifiers: *Manure, *Stratum, Pollution, Solution

Research was done to investigate, under simulated conditions, the transport rate of cattle manure through a wet porous stratum while the manure is consumed by microorganisms in both the porous body and the adjacent body of water. To prepare the cattle manure solution for use in the experiments, the manure was mixed with a large amount of water. During a period of three days, it was agitated several times: After settling for two days, the solution was filtered three times to remove suspended manure particles. Experimental observations were made to determine the diffusion coefficient and the biological reaction rate constant of the manure solution. Values of approximately 6.76 x 10(6) cm (2) s (-1) for the diffusion coefficient and 3.05 x 10 (-2) day (-1) for the reaction rate constant of 25 +/—2°C were obtained. (Cameron-East Central)

## 2171-A6, B2

### SLICK DISPOSAL SETUP-DAIRYMAN DESIGNED IT

Successful Farming, Vol. 73, No. 5, p. K4, March, 1975. 3 fig.

Descriptors: *Waste disposal, *Lagoons, Water, Dairy industry, Odor
Identifiers: *Holding pit, Flushing, Manure

With advice from a University of Missouri dairy and agricultural engineering specialist, Charles and Clem Schabbing have designed and installed a labor-saving manure disposal system. The Schabbings use a utility tractor and blade to scrape manure into a holding pit from their new free-stall barn. The pit is located in the corner of a sloping concrete pad extending from the barn and connecting with a holding area adjacent to the milking parlor. Twice a day waste is flushed from the holding area into the pit, using water pumped from the lagoon. Vented so a vacuum can't form, the pit empties as fast as the liquid manure can rush through the 6-in. buried plastic pipe. The Schabbings report there is almost no odor, certainly not enough to be offensive. (Cameron-East Central)

## 2172-A11, D1, E3

### RECYCLED WASTE IN FEEDS DESCRIBED

Feedstuffs Southeastern Correspondent
R. H. Brown
Feedstuffs, Vol. 46, No. 49, p. 34, December 2, 1974

Descriptors: *Recycling, *Farm wastes, *Feeds, Cattle, Poultry, Florida, Alabama
Identifiers: *Refeeding, *Waste management, Swine, Fiber, Waste fat

Dr. W. B. Anthony, of Auburn University, told feedmen at the Florida Feed Conference that one day in the near future, feed manufacturers will be using an animal waste product in commercial feeds. There are at least two ways to manage animal wasts for feed. One is to take components and process them and put them back into feed. Early work at Auburn was to take animal waste from cattle, put it over a screen, wash it and recover the fiber and use that as an animal feed. Washed fiber is now being used in many areas, especially dairies, using a flush-down system which eliminates the fiber from water-treating processes. Anthony related the latest trials in Alabama with yearling cattle. Animals were on test 112 days, ending July 15 and slaughtered seven days later. According to Dr. R. L. West of Florida, increased use of yield grading and proposed changes in grading systems by the USDA are steps in the right direction toward solving problems of today's waste fat in beef carcasses. (Cameron-East Central)

## 2173-C2, E3, F1

### PAUNCH CONTENT-BLOODMEAL MIXTURE AS PROTEIN SUPPLEMENT IN FEEDLOT RATIONS

J. K. Matsushima, C. Byington, and W. E. Smith
Beef Nutrition Research, Colorado State University Experiment Station, General Series 934, p. 42-44, May, 1974

Descriptors: *Feeds, *Proteins, Feedlots, Drying, Cattle, Costs
Identifiers: *Paunch content, *Bloodmeal, Cottonseed meal

When paunch content and blood meal are dried and blended in equal proportions, the protein content is similar to cottonseed meal (45% protein) or other similar protein supplements commonly used in feedlot rations. Research was done in an attempt to compare the feeding value of dried paunch content-bloodmeal mixture with cottonseed meal as a protein supplement in feedlot rations. Three treatments (protein supplementation) involved in this trial were: (1) control or cottonseed meal; (2) paunch content-bloodmeal in equal proportions (on dry basis); and (3) a 50:50 mixture of cottonseed meal supplement with paunch content-bloodmeal mixture. The supplements were fed at the rate of 0.75 lbs. per head daily. The results of the feeding trial show that paunch contents from packing plants where fat cattle are slaughtered primarily can be used advantageously if dried and blended with dried bloodmeal. When used as a protein supplement, the cattle will consume it readily and support the protein needs in feedlot rations. (Cameron-East Central)

## 2174-A4, A5, A6, A7, A10, B2, B3, E2, F1

### A SYSTEMS APPROACH TO CATTLE FEEDLOT POLLUTION CONTROL

Department of Chemical Engineering, Texas Tech University, Lubbock
G. F. Meenaghan, D. M. Wells, and E. A. Coleman
Presented at the 72nd National Meeting, American Institute of Chemical Engineering, St. Louis, Missouri, May 21-24, 1972, 29 p. 24 fig. 5 tab.

Descriptors: *Cattle, *Feedlots, *Water pollution control, Air pollution, Fertilizers, Land disposal, Irrigation, Chemical properties
Identifiers: Slotted floors, Soil injection

Very simple and relatively low-cost solutions are available for the problem of water pollution caused by cattle feedlots. Vastly more complex and difficult problems to solve are the air pollution and solid waste disposal problems resulting from conventional feedlot operations. Farmers do not generally consider it to be economically feasible to use manure as fertilizer, Hence, about the only option open to most feedlot operators for disposal of solid waste is to provide a large tract of land on which the waste can be stored more or less indefinitely . . . Veritable mountains of manure exist . . . these mountains are frequently ignited by spontaneous combustion, thereby providing an additional significant source of air pollution. A nearly ideal feedlot, that of the Green Valley Cattle Company at San Marcos, Texas, is described. It has slotted floors over pits cleaned daily, is completely roofed, and provides for irrigation by means of a 2000-gal. capacity honeywagon equipped with chisels which dispose of the manure below surface thus avoiding the otherwise inevitable odor and fly problems. (Whetstone, Parker, and Wells-EPA)

## 2175-A2, A5, A11, B1, E2

### THE DESIGN AND OPERATION OF AN OPEN-FRONT, SLOTTED FLOOR BEEF CONFINEMENT BUILDING

Area Extension Engineer, Illinois University
M. D. Hall and F. McRoberts
Presented at 1969 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 9-12, Paper No. 69-911, 3 p.

Descriptors: *Design, *Confinement pens, Costs, Waste disposal, Ventilation, Cattle, Agricultural runoff, Fertilizers, Performance
Identifiers: *Waste management, *Feeding systems, Slotted floor

In using confined feeding systems, practically all feeders are looking for the same thing: (1) profit on animals going through the system, (2) minimum labor and management requirements, (3) minimum odor and waste disposal problems, and (4) provision of a market for feed that is not easily marketable. There are four basic components to any feeding system that must be fit together: (1) feeding system, (2) waste disposal system, (3) environmental system, and (4) animal handling system. The system studied was designed with a bunk feeding system. The waste disposal system consisted of a slotted floor with a pit under it to catch the waste and pumps to remove it. The main objective with the environmental system used was to prevent drafts, keep the cattle dry in the winter and provide good shade with the best natural ventilation possible. Performance of cattle in the open-front confinement cattle barn was excellent when compared with cattle in conventional feedlots. No significant health problems were experienced with the inside or outside cattle, and the open-front solar-type beef barn should work well in almost any climate with minor changes. The manure was concentrated with no runoff, allowing maximum use of manure as fertilizer and also allowing control of ground water pollution to some extent. (Battles-East Central)

## 2176-A2, B1, B4, F1

### RECYCLING, ENERGY AND AGRICULTURAL ECONOMICS

Assistant Professor of Economics, California State University, Chico
M, Perelman
Compost Science, Vol. 14, No. 5, p. 26-27, September/October, 1973.

Descriptors: *Recycling, *Economics, *Agriculture, *Energy, Transportation, Organic wastes.
Identifiers: Production

Professor Michael Perelman expounds upon the inefficient output of energy to produce less energy in the form of food. In terms of energy recycling capabilities, America's agricultural system is not as efficient as those in many other countries. The production and transportation systems used are wasteful and poorly integrated, thus increasing energy loss. Furthermore, there is a tremendous amount of energy included in waste products that is not being utilized. What is needed is a system of small farms integrated into their communities so that people can live in a close cycle, where a quality of the environment and a quality of life can be maintained. (Battles-East Central)

## 2177-A11, B2, B3, D1, D2, D3, E2, E3, F1

### RECYCLING POULTRY WASTE AS FEED: WILL IT PAY?

Economic Research Service, U. S. Department of Agriculture
R. Gar Forsht, C. R. Burbee, and W. M. Crosswhite
Agricultural Economic Report No. 254, March 1974, 51 p, 1 fig, 33 tab, 61 ref.

Descriptors: *Recycling, *Feeds, *Economics, Incineration, Drying
Identifiers: *Refeeding, *Dried layer waste, Broiler waste, Land, disposal, Anaerobic lagoons, Aerobic lagoons, Oxidation ditch, Composting

The costs and return of feeding recycled dried layer waste (DLW) to livestock and poultry are compared; less information is available on recycling broiler waste. Alternative poultry-waste management systems are also compared. For flock sizes of 80,000, 50,000, and 10,000 cage layers, the cost of producing and feeding of 1 ton of DLW is $25, $30, and $46, respectively. On-farm processing and feeding of DLW do not appear to be economically feasible for the 10,000 layer operation. However, it may be feasible for the larger operations. The highest net returns are attained by the larger operations when DLW is fed at 12.5 percent of the ration. Since a layer operation can only incorporate a portion of the poultry manure back into feed, alternative disposal systems must still be considered, and disposal and anaerobic lagoon treatment are the least expensive alternative poultry-waste management systems. Mechanical drying, aerobic lagoon treatment, oxidation ditch treatment, and combined anaerobic-aerobic lagoon treatment fall within the intermediate cost range. Composting and incineration are the most expensive. Layer waste can also be dried and fed to dairy and beef cattle and broiler waste—both ground and ensiled—has been fed to dairy and beef cattle. Rations containing up to 30 percent DLW have been fed to dairy and beef cattle without significant problems. Both ground and ensiled broiler wastes have been fed to dairy and beef cattle with little effect on carcass quality. (Battles-East Central)

## 2178-B2, B4, E2, F1

### MANURE SLURRY STORAGE, PROCESSING, AND PUMPING

Vice President, AGPRO, Inc., Santa Rosa, California
D. J. Gribble
Presented at 1967 Winter Meeting, American Society of Agricultural Engineers, Detroit, Michigan, December 12-15, 1967, Paper No. 67-626, 4 p.

Descriptors: *Waste storage, *Pumping, *Slurries, Sprinkler irrigation, Cost, Equipment, Dairy industry
Identifiers: *Processing.

When AGPRO developed its manure-flush system in 1962, there was still one problem to solve—60 to 100 gallons of water, waste grain, hay, bedding, and manure per cow per day also had to be disposed of. Hauling was not practical because of the volume, and the sprinkling systems available were not meant to handle large amounts of solids, and particularly long material such as hay and straw. Work and experimentation led to the development of the AP-100 Series High Pressure Manure Slurry Processing and Pumping Plants. These units meet requirements by using a combination of equipment. (1) They utilize a high pressure pump delivering the slurry through conventional irrigation tubing to a special rubber nozzled field sprinkler. (2) They contain a processing unit that will reduce all normal foreign material such as hay, bedding, feed, etc., to a size that will pass through the pump and sprinkler head. (3) The cost of purchase and operation of the plants is less than the tractors, manure spreaders, hydraulic loaders and other equipment that they replace. However, research is yet to be done on the economics and mechanical features involved in distribution of manure by means of high pressure pumps and sprinklers. (Battles-East Central)

## 2179-A2,A3,A4,A5,A8,A12, C2,E2

### THE EFFECT OF FARM WASTES ON THE POLLUTION OF NATURAL WATER

Agricultural Engineering Department, Wisconsin University, Madison
S. A. Witzel, N. E. Minshall, E. McCoy, R. J. Olsen, and K. T. Crabtree
Presented at 1969 Annual Meeting, American Society of Agricultural Engineers, Purdue University, West Lafayette, Indiana, June 22-25, 1969, Paper No. 69-428, 24 p.

Descriptors: *Farm wastes, *Water pollution, *Waste disposal, Denitrification, Nitrification, Nitrates, Soil profiles, Groundwater pollution, Nutrients, Agricultural runoff, Feedlots, Irrigation, Fertilizers
Identifiers: *Waste handling

Results are given of studies concerning the enrichment of natural surface and sub-surface waters by animal wastes. The studies expose the possibility of adverse trends in waste handling already developed producing a critical situation in some areas. Areas researched through use of the 2500 samples of water collected included: (1) biological nitrification, (2) biological denitrification, (3) migration of nitrates in soil profiles as a source of nitrates in sub-surface waters, (4) effect of agricultural practices on groundwater quality, (5) groundwater pollution in the Rib Falls Community, (6) nutrient losses on one small Lake Mendota Watershed, and (7) nutrients in base flow of Southwestern Wisconsin streams. Conclusions drawn from the studies were: (1) nutrient losses in the base flow of southwestern Wisconsin streams during this period of high winter runoff totaled only 25 percent as much N and K and 10 percent as much P as in the suurface runoff, (2) heavy manure applications in the vicinity of farm buildings or large feedlots can result in dangerously high nitrate concentrations in farm wells, (3) heavy supplemental irrigation, combined with repeated heavy nitrogen fertilizer applications may result in an increase in the nitrates in groundwater, (4) heavy annual application of manure and/or fertilizer can raise the groundwater to the toxic level of nitrates, and (5) continuous records of nitrate levels in selected rural wells will indicate any adverse conditions, hopefully, in time to permit effective corrective measures to be taken or to prepare for alternative sources of supply, (Battles-East Central)

## 2180-D2, E3, E4

### HYDROGASIFICATION OF CATTLE MANURE TO PIPELINE GAS

Pittsburgh Energy Research Center, U. S. Department of the Interior, Bureau of Mines, Pittsburgh, Pennsylvania
K. Kiang, H. F. Feldmann, and P. M. Yavorsky
Presented at the 165th National Meeting, American Chemical Society, Dallas, Texas, April 8-13, 1973, p. 15-23. 3 fig. 2 tab. 4 ref.

Descriptors: *Gases, *Recycling, Cattle, Autoclaves, Carbon dioxide, Hydrogen, Oil
Identifiers: *Hydrogasification, Reactors, Tar

In this report, experimental data are discussed showing the quality and yield of pipeline gas that can be generated by directly reacting cow manure with hydrogen at gasification conditions. Except for one experiment conducted with dried cow manure in a continuous free-fall dilute-phase reactor, the experiments with manure and solid wastes were conducted in a batch autoclave. The autoclave body was fitted with a pyrex glass liner into which the autoclave charge was placed and a thermocouple was inserted into the liner. The autoclave was assembled and weighed and then installed in an electric furnace which heated the autoclave at a rate of 8 degrees C per minute. Experiments were conducted at temperatures of 475, 550 and 650 degrees C. At temperatures low enough to allow appreciable yields of ethane, the cattle manure was readily converted to pipeline gas by hydrogasification and tars or oils were produced. It's possible to produce a SNG with a heating valve in excess of 1,000 Btu/scf by simply hydrogasifying the manure, shifting a rather low concentration of CO to $CO_2$, and scrubbing out $CO_2$ without any need for methanation. Manure placed in the continuous free-fall dilute-phase reactor was more reactive than it was in a batch reactor because of much higher heatup rates and the low concentration of particles in the dilute-phase reactor, (Battles-East Central)

## 2181-A6,B1,B4,C2,D3,E2

### AEROBIC STORAGE OF DAIRY CATTLE MANURE

C. M. B. Robson
M. S. Thesis, Department of Civil Engineering, Purdue University, June, 1963, 51 p. 1 fig. 28 tab., 17 ref.

Descriptors: *Waste storage, *Aerobic conditions, *Dairy industry, Odor
Identifiers: *Land spreading, *Loading rates, Volatile solids, Kjeldahl nitrogen

Field spreading of dairy cattle manure is the most generally used method of disposal in the north central United States. When spreading is not feasible, the manure must be stored. Research was thus prompted concerning aerobic storage of dairy cattle manure. The manure was stored at 4° and 24° C at loading rates of 60, 80, 100 and 120 grams of manure per day per 4 liter storage volume. The suitability and accomplishments of storage were measured by the analytical procedures, total and volatile solids, chemical oxygen demand, and total kjeldahl nitrogen. The intensity of odors was evaluated. The following conclusions were reached: (1) Of the loading rates tested, the amount of loading did not influence the degree of degradation. (2) volatile solids decreased 20 percent at 4° C and 42 percent at 24° C. (3) Appreciable amounts of material with a chemical oxygen demand were removed during aerobic storage, (4) Kjeldahl nitrogen content, per gram of total solids, of the material remaining after aerobic storage is higher than kjeldahl nitrogen content, per gram of total solids, of the raw manure. (5) Foaming was a major problem. (6) Aerobic storage holds promise of minimizing odor problems encountered in spreading unaerated material after storage. (Merryman-East Central)

## 2182-A4,A5,A8,A12,B1,C2

### NITRATE PROBLEMS IN PLANTS AND WATER SUPPLIES IN MISSOURI

G. E. Smith
Presented at Second Annual Symposium on the Relation of Geology and Trace Elements to Nutrition, 92nd Annual Meeting American Public Health Association, New York City, October 7, 1964, 36 p. 9 tab., 28 ref.

Descriptors: *Nitrates, *Nitrites, *Nitrogen, *Water, *Missouri, *Toxicity, *Water pollution, *Soil contamination, *Ground water pollution, Leaching, Feedlots, Sampling, Fertilizers, Aquifer, Wells, Public health, Surface waters
Identifiers: *Plants, Cyanosis

Progress on research for sources of nitrogen which result in excess nitrate-nitrite in plants and water in Missouri is reported. Water samples were collected from 5000 sources (both rural and urban) from 45 counties that represent nine distinct geologic areas in Missouri. All samples were tested qualitatively for nitrites by the sulfanilic acid method. Forty-two percent of the 5000 sources surveyed contained over 5 ppm of nitrate-nitrogen. Soils in feedlots were sampled and some were found to contain concentrations of nitrates up to 330 p/a of nitrogen to a depth of 10 ft. Both deep wells and spring waters were found to contain nitrates. Analyses were made of vegetable crops. Intake of nitrate from vegetables was not large. (Cartmell-East Central)

## 2183-B2, C2, D3, E3, F1

### ANAEROBIC DIGESTION OF DAIRY FARM SLURRY

Department of Biological Sciences, Surrey University
C. Bell
Effluent and Water Treatment Journal, Vol. 13, No. 4, p. 232-233, April, 1973.

Descriptors: *Dairy industry, *Anaerobic digestion, *Slurries, Methane, Costs
Identifiers: *Pilot scale anaerobic digestor

Merrist Wood Agriculture College has designed and constructed a pilot scale anaerobic digestor. Sixty liters of a 1:7 faeces/water mixture is fed to the reactor chamber once every 18 days. The slurry is digested at 35 degrees C for 18 to 21 days, after which time a displacement effect pushes the digested material into the primary oxidation tank and eventually to a disposal pit. The main advantages are mechanization of manure handling, prevention of loss of nitrogen from raw manure, control of the loss of organic matter from manure, the destruction of weed seeds during digestion, and recovery of methane gas. (Battles-East Central)

## 2184-C2, D2, D3, E3

### METHANE PRODUCTION FROM WASTE

University College, Cardiff
D. A. Stafford
Effluent and Water Treatment Journal, Vol. 14, No. 2, p. 73-79, Feb., 1974.

Descriptors: *Methane, Methane bacteria, *Sewage, *Waste treatment, *Anaerobic digestion, Farm wastes, Microbiology, Fuels, Gases, Inhibitors

Much of the fundamental microbiology of the organisms involved in methane production is not understood. It is known that methane bacteria share common properties. They all grow only in the absence of oxygen and they all have narrow substrate requirements. Methane can be produced by two stage hydrolysis/gas production anaerobic digestion plants, but sometimes these digesters cease their hydrolysis and subsequent gas production. The reasons are not always clear. It is known that there are inhibitors to digester gas production (ie. copper inhibits anaerobic digestion of pig waste), but much is yet to be learned. Much research is needed if we are ever to reap the benefit of using domestic sewage as a source of power. (Merryman-East Central)

## 2185-D3, E3, E4, F1

### PRELIMINARY FLOW SHEET AND ECONOMICS FOR PRODUCTION OF AMMONIA SYNTHESIS GAS FROM MANURE

Department of Chemical Engineering, Texas Tech University, Lubbock
W. S. Wideman, J. E. Halligan and H. W. Parker
Presented at 76th National Meeting of American Institute of Chemical Engineers, Tulsa, Oklahoma, March 10-13, 1974, 20 p. 3 fig. 6 tab. 12 ref.

Descriptors: *Economics, *Ammonia, *Synthesis, *Farm wastes, Recycling, Feed lots, Fertilizers, Oxidation, Costs
Identifiers: *Flow Sheet, *Production, *Manure, Char, Sulfur, Waste management.

The need for ammonia in the United States has increased at a tremendous rate in the past few years. New processes for the production of ammonia synthesis gas are being examined to meet the rising costs of conventional natural gas feedstocks. One process, the partial oxidation of cattle feedlot wastes to produce the synthesis gas, has been under investigation at Texas Tech for the past year. The long term goals of the project were designed to complement the agricultural economy of the High Plains area of Texas, in that cattle wastes would be disposed of by conversion into ammonia fertilizer, which in turn is used in the production of cattle feeds. In terms of solid waste disposal, the investment cost of the process is $4,625 per daily ton of manure processed, but in terms of production, the investment becomes $10,165 per daily equivalent ton of ammonia. This project has been shown to be technically and economically attractive. For this reason, along with the probability of more restrictions on natural gas feedstock supplies, continued development of the process is advisable. (Russell-East Central)

### 2186-A6,B2,B4,C2,D3,E1 E2

## HANDLING MILK-PARLOR WASTE

Department of Microbiology, Otago University
Dunedin, New Zealand
R. G. Bell, and J. B. Robinson
Canadian Agricultural Engineering, Vol. 14, No. 2, p. 56-58, December, 1972.

Descriptors: *Dairy industry, *Farm wastes, *Cattle, *Waste treatment, *Waste storage, *Waste disposal, *Aeration, *Canada, Chemical analysis, Odor, Chemical oxygen demand, Septic tanks, Lagoons, Irrigation, Nitrogen, Hydrogen ion concentration
Identifiers: *Milking-parlor wastes

A study was undertaken to assess the treatability of a typical milking-parlor effluent by aeration to help determine the most feasible disposal method for the watery waste. Four day's aeration of milking-parlor waste produced a clarified effluent with a BOD of 200 parts per million. This effluent was not of a sufficiently high standard for direct discharge into a water course. It was concluded that aeration, followed by surface water discharge, and septic tank disposal are unacceptable practices for disposal of milking-parlor waste in Ontario. Storage in an aerobic lagoon combined with spray or furrow irrigation is a feasible alternative but is hampered by the winter conditions prevailing in the province. Where the manure is already being handled as a liquid, the most satisfactory alternative would appear to be combining the milking-parlor waste with the manure where liquid storage is available. (Cartmell-East Central)

### 2187-A5, A8, A12, C2, E2

## NITRATES IN SOIL AND GROUND WATER BENEATH IRRIGATED AND FERTILIZED CROPS

United States Department of Agriculture, Fresno, California
H. I. Nightingale
Soil Science, Vol. 114, p. 300-311, 1972. 6 fig. '7 tab., 12 ref.

Descriptors: *Nitrates, *Soil contamination, *Groundwater pollution, *Irrigation, *Fertilizers, *California, *Farm wastes, Cattle, Poultry, Septic tanks, Soils, Analysis

An area of 334 sq. mi. in Fresno County, California, was studied intensively for nitrates beneath irrigated and fertilized crops. The fertilizers used included steer and chicken manure. "No harmful effects, from the health standpoint, will be encountered even if present fertilizer practices are continued Continued uncontrolled 'suburban' expansion with its septic tank systems and a shift in agricultural production from crops (grapes, etc.) with low N requirement to truck and orchard crops with higher nitrogen requirements may be a cause of concern." (Whetstone, Parker, Wells-Texas Tech University)

### 2188-A7,A11,B2,B4,C2,C3 F3

## AIR POLLUTANTS IN SWINE BUILDINGS

Oklahoma State University, Stillwater, Oklahoma
D. L. Lebeda

Descriptors: *Air pollution, *Swine, *Confinement pens, *Farm wastes, Gases, Chemical analysis, Toxicity, Ventilation, Bacteria, Sampling, Carbon dioxide, Sulfur dioxide, Hydrogen sulfide, Ammonia
Identifiers: *Swine buildings, Air borne bacteria

Objectives were to determine the concentrations of ammonia, hydrogen sulfide, carbon dioxide, and air borne bacteria within a swine building with fluid waste handling, and to relate the concentration of gases to the management, ventilation, and building parameters of a confinement building. The absorption method was used in determining all of the gases, and none of the gas concentrations determined were above the threshold level for humans. The average carbon dioxide concentration was from 2, to 2.5 times higher than the normal atmospheric level of 300 ppm.. The average gas concentrations with ventilation were 8.1, 0.27, and 0.025 ppm of ammonia, hydrogen sulfide, and sulfur dioxide, respectively. Without ventilation, in six hours the gas concentrations were three times the two-week values, with ventilation, for ammonia and hydrogen sulfide and six times that for carbon dioxide. The average number of air borne organisms found was 4,800 per cubic feet. What is needed now is a study to determine both the chronic and acute level of gas concentration on confinement animals. (Russell-East Central)

### 2189-B5, C1, C3, E4

## DIGESTION OF POULTRY MANURE BY MUSCA DOMESTICA

Department of Animal Sciences, Colorado State University, Fort Collins
B. F. Miller, J. S. Teotia, and T. O. Thatcher.
British Poultry Science, Vol. 15, p 231-234, 1974. 2 tab.

Descriptors: *Digestion, *Farm wastes, *Poultry, *Aeration, Larval growth stage, Larvae, Temperature, Moisture, Protein
Identifiers: *Manure, *Musca domestica

Research was undertaken to evaluate the ability of Musca domestica to grow on poultry manure to stabilize and yield useful, easily harvested products to combat this problem. As temperature was increased from 17 to 38°C, the time required to develop from egg to pupae was decreased from 11 to 5 days. The optimum level of inoculation was found to be from 0.5 to 1 g of house fly eggs per kg of fresh manure. Larval development significantly modified poultry manure. Approximately 80% of organic matter in the manure was destroyed during the developmental period. Fifty-eight per cent of the moisture was lost while the mineral content was not changed significantly. The physical consistency of the manure became somewhat granular and could be dried readily because of the increased surface area, small particle size and improved aeration. The residue was stabilised and was not nearly as offensive as the fresh material. The residue contained about 15% protein after the pupae were removed. (Cartmell-East Central)

### 2190-A2, A3, B1, C2, F4

## AGRICULTURAL RUNOFF—CHARACTERISTICS AND CONTROL

Cornell University, Ithaca, New York
R. C. Loehr
Proceedings Paper No. 9406, Abstract No. 5042, ASCE Sanitary Engineering Division Journal, Vol. 98, No. SA 6, p. 909-925, December, 1972.

Descriptors: *Agricultural runoff, *Control, Erosion, Feed lots, Farm wastes, Livestock, Pollutants, Ponding, Chemical characteristics, Fertilizers, Nutrients
Identifiers: Land disposal

Some pollution problems due to agricultural runoff are discussed and put into perspective. Erosion, rural runoff, and fertilizers are discussed in detail. Pollution contributions from feed lots and land used for manure disposal can have the largest concentrations but are intermittent and are able to be controlled by the use of good management practices. Contributions from crop land are more difficult to control although possibilities exist through the use of better timing of fertilizer applications and soil conservation practices. Pollutional contributions from many rural areas can be due to natural, geological, and soil conditions. Range, pasture, and woodland are diffuse sources that represent background or natural contributions that will be extremely difficult to control. This comparison of contaminant sources indicates that not all agricultural contributions are insignificant and some may require control. (Cartmell-East Central)

### 2191-A6,B2,B3,B4,D1,D2, D3,E2

## HOW EGGMEN ARE SOLVING THE ECOLOGY PROBLEM

Department of Poultry Science, Cornell University, Ithaca, New York
C. E. Ostrander
Poultry Tribune, p. 28, 32, 36, 2 fig.

Descriptors: *Poultry, *Ecology, *Waste storage, *Waste treatment, *Waste disposal, Recycling, Odor, Dehydration, Drying, Lagoons, Oxidation lagoons, Aerobic conditions.
Identifiers: *Eggmen, Soil injection, Isolation

A noted authority on waste management outlined a number of approaches that are being used to solve poultry pollution problems. Among them are: (1) use of in-house drying, (2) liquid systems-untreated and oxidation system, (3) lagoons-natural and aerated, (4) soil injection, (5) dehydration, and (6) isolation. While each of these approaches has its advantages, no one specific method will fit every situation. (Cartmell-East Central)

### 2192-A1,A4,A5,A6,A7,A10, F2

## COMMERCIAL FEEDLOTS—NUISANCE, ZONING AND REGULATION

D. J. Paulsen
Washburn Law Journal, Vol. 6, p. 493-507, 1967, 80 ref.

Descriptors: *Feedlots, *Nuisance, *Zoning, *Regulation, Commercial, Agriculture, Air pollution, Water Pollution, Pests, Odor, Abatement, Livestock, Legal aspects,
Identifiers: Noise, Injunction.

Livestock feedlots are not public nuisances, per se, but they may become nuisances by virtue of their operation or the manner in which they are kept. Each case must of necessity be decided by examination of all the facts and circumstances surrounding the particular alleged nuisance. Among the facts and circumstances to be considered are: the type of neighborhood, the nature of the complaint, the proximity of those alleging the injury, and nuisance frequency. The remedies for nuisance are damages at law and injunction or abatement in equity. Zoning and regulation by public agencies are methods used to control the location and operation of feedlots, but because most zoning laws and regulations are the product of agrarian oriented legislatures, feedlots have been exempted to a certain degree from zoning and regulations by statute. A trend is starting in the East, however, to consider commercial feedlots (as opposed to the usual farm feedlots) as being more in the nature of an industry. This impetus is expected to spread. (Ballard-East Central)

### 2193-A4,B3,C1,D1,D2,D3, E1,E2

## TAKING CARE OF WASTES FROM THE TROUT FARM

R. Jenson

National Fisherman, Vol. 52, No. 9, p 15-A, February, 1972. 9 fig.

Descriptors: *Fish hatcheries, *Trout, *Water pollution, *Settling basins
Identifiers: *Fish wastes, *Waste disposal, *Solids removal

After development of obnoxious conditions in the Jordan River near a picnic area, the Jordan River Watershed Committee asked the Jordan River National Fish Hatchery near Alba, Michigan, to correct the undesirable river conditions. It was determined that solid wastes from the hatchery were causing the problem. After studying solids removal attempts of Lamar National Fish Hatchery Development Center in Lamar, Pennsylvania, the Jordan River National Fish Hatchery set about designing its own settling basin. Important factors to be considered were retention time, weight of wet solids, water velocity and distribution, and depth of water. The final design consisted of two compartments, each of which had two trenches connected to a manhole pump which would separate and trap the solids. The wastes were then to be disposed of in one of the following ways: (1) as direct applied land fertilizer, (2) in a sewage disposal system, (3) as raw material for commercial fertilizer, (4) by transfer to a municipal sewage plant, or (5) by incineration. (Merryman-East Central)

### 2194-A6, B2, C2, D1, D2, F1

### TREATMENT OF LIQUID HOG MANURE TO SUPPRESS ODORS

Illinois University, Urbana
W. C. Hammond, D. L. Day and E. L. Hansen
Presented at 1966 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 6-9, 1966, Paper No. 66-928, 14 p. 12 fig., 5 tab., 3 ref.

Descriptors: *Waste treatment, *Liquid wastes, *Odor, *Lime, *Chlorination, Anaerobic conditions
Identifiers: *Swine, *Sand bed filter

Liquid manure becomes anaerobic immediately when collected in pits beneath self-cleaning slotted floors. In this state, it supports anaerobic bacteria that produce objectionable odors. The possibility of adding lime and chlorine to liquid manure to prevent these gases and odors was investigated in this study in conjunction with sand filtering of the treated waste. The study showed that chlorination virtually stops the production of ammonia, hydrogen sulfide and methane and considerably reduces carbon dioxide production. Liming does not have much effect in controlling ammonia liberation but affects carbon dioxide and methane production. Neither methane or carbon dioxide produces an objectionable odor, but they both indicate changes in the digestion process with changes in concentration. About 0.15 to 0.16 pound of lime per 100-pound hog per day was found to be the amount necessary to maintain the desired pH. Costs of lime addition are given. Use of powdered calcium hypochlorite was discontinued when early attempts in mixing the chemical into waste were not satisfactory. Trapping solids and organic matter was effectively achieved by the sand-bed filter. BOD, COD and total solids were reduced to about half during the first passage through the sand-bed filter of the waste. (Kehl-East Central)

### 2195-B3, B4, C1, C2, F1

### ROOFED VS. UNROOFED SOLID MANURE STORAGES FOR DAIRY CATTLE

College of Agricultural and Life Sciences, University of Wisconsin Experimental Farm, Ashland, Wisconsin
G. H. Tenpas, D. A. Schlough, C. O. Cramer and J. C. Converse
Presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-949, 20 p., 5 fig., 11 tab., 7 ref.

Descriptors: *Waste storage, *Dairy industry, *Seepage, *Costs, Nutrients, Chemical properties, Physical properties

The University of Wisconsin Experimental Farm at Ashland has investigated for three winters the solid storage of manure from a stanchion type dairy barn. The structure was roofed for the third year of the trial. Results on the unroofed structure have been given previously by Cramer, et. al., 1971. The manure handling facilities included an extension to the barn cleaner elevator, horizontal distribution conveyors, a 13,000 cubic ft. bunker type manure storage, and a 3000 cu. ft. detention pond. Floor drains allowed the liquids to seep into a sampling tank and detention pond for storage. The study showed that the chemical and physical characteristics of the manure were not affected by the addition of the roof. The total amount of stack seepage was reduced by 34% by the addition of the roof, although the quantity of summer seepage was largely due to less evaporation under the roof. Several disadvantages of the roof are increased cost and greater difficulty in servicing the barn cleaner drive unit and other conveyors. Another disadvantage is that although the buildup of manure on the conveyors did not cause a problem; it did not thaw as readily. Volume measurements were made on manure production, including stored volume of solids, seepage and bedding and these are provided in tables. Also given are the results of laboratory analyses of the fresh manure, stored manure and seepage. (Kehl-East Central)

### 2196-A1, A4, A5, A6, B2, B3, D1, D3, F1, F2, F4

### FEEDLOT WASTE MANAGEMENT: WHY AND HOW

Missouri River Basin Animal Waste Management Pilot (Steering) Task Group.
Environmental Protection Agency Report, Kansas City, Missouri, June, 1971, 45 p. 10 fig.

Descriptors: *Feedlots, *Legal aspects, Terracing, Lagoons, Design, Water Pollution control, Odor
Identifiers: *Waste management, Location, Mounding, Settling channels, Holding ponds, Technical assistance, Financial assistance

Basic information on the problem of cattle feedlot waste management and the pollution arising from these operations is presented in a non-technical manner. The factors that cause feedlots to pollute and the magnitudes pollutants may reach are discussed along with some management factors and structural and mechanical means to help control water pollution. Sources of technical assistance in design and layout of control facilities and the water pollution control agencies for the ten Missouri River Basin states are listed. Existing animal waste control regulations are also furnished for these ten states. (Missouri River Basin Animal Waste Management Pilot (Steering Task Group)

### 2197-B3, C1, C3, D2, D3, E2, E3, F2

### CHANGING FROM DUMPING TO RECYCLING. PART III: COMPOSTING AND MISCELLANEOUS PROCESSES

C. G. Golueke
Compost Science, Vol. 13, p. 5-7, May-June, 1972.

Descriptors: *Recycling, *Organic Waste, Economics, Aeration, Moisture content, Temperature
Identifiers: *Composting, *Land disposal, *Refeeding, Pyrolysis, Carbon-nitrogen ratio, Particle size.

"Composting is the biological decomposition of organic matter under controlled conditions." Consideration must be given to aeration, moisture content, temperature, carbon-nitrogen ratio, and particle size. Manure can be composted in 8 to 14 days without undue difficulty. A mixture of manure and sawdust or straw makes an excellent compost. Land disposal may be employed directly if the assimilatory capacity is not exceeded, or may be employed for the sludges produced by the other methods. Use of organic wastes in animal feedstuffs holds great promise provided that the possibility of bacterial and viral transmission is thoroughly explored, that the concentration of toxic materials is investigated, and that Food and Drug Administration approval is secured. Pyrolysis "is as yet in the reseach stage." Assorted fermentations are under investigation. "At present, the economics of the processes are highly unfavorable." (Whetstone, Parker, & Wells-Texas Tech University)

### 2198-A6, B1, B4, C2, D3

### STORAGE OF POULTRY MANURE WITH MINIMUM ODOR

Department of Agricultural Engineering, Purdue University, Lafayette, Indiana
D. C. Ludington, D. E. Bloodgood, and A. C. Dale
Presented at 61st Annual Meeting, American Society of Agricultural Engineers, Detroit, Michigan, December 12-15, 1967, Paper No. 67-632, 19 p. 8 fig., 4 tab., 3 ref.

Descriptors: *Waste storage, *Poultry, *Odor, *Oxidation-reduction potential, Aeration, Hydrogen, sulfide

Air pollution with objectionable odors produced from stored poultry manure has become a recognized problem in much of the United States. Changes in animal management, increased concentrations of animals and increased proximity between people and poultry operations has caused these odors to become more pronounced and less tolerable in the past few years. The main objective of this study was to find the means of reducing or eliminating stored poultry manure odors. This paper contains the results of two main tests. These tests were replicates of each other for statistical analysis. The study showed that the ORP (oxidation-reduction potential) of stored manure was automatically controlled by regulating the rate of aeration. When chicken manure was stored without aeration, significant quantities of hydrogen sulfide were produced; insignificant quantities of hydrogen sulfide were produced with aeration. The only procedure for obtaining a meaningful measure of degradation is the analysis of all the chamber contents. It was impossible to obtain accurate measurement of low concentration of dissolved oxygen in fluid chicken manure. (Kehl-East Central)

### 2199-A4, B1, F2, F3

### STATE REGULATIONS PERTAINING TO LIVESTOCK FEEDLOTS

Livestock Engineering and Farm Structures Research Branch, U. S. Department of Agriculture, Beltsville, Maryland
W. F. Schwiesow
Presented at 1971 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 7-10, 1971, Paper No. 71-919, 16 p.

Descriptors: *Regulations, *Feedlots, *Livestock, *Water pollution

The need for water pollution regulation led to the establishment of water quality standards through the Water Quality Act of 1965. Through some rather unusual channels, the need to include the livestock feedlot industry became apparent. Investigations on fish kills and polluted streams established that feedlots and dairy farms were a major cause. A focus on livestock wastes as a pollution source drew attention to the need for changes in agricultural practices. This brought about livestock feedlots now being subject to water quality control regulations. Need for uniformity in these regulations is recognized and various reasons are given. A listing of state offices that may be contacted for additional information on such regulation is provided. (Kehl-East Central)

### 2200-A7, B1, B4, C2

### THE INFLUENCE OF VENTILATION ON DISTRIBUTION AND DISPOSAL OF ATMOSPHERIC GASEOUS CONTAMINANTS

Department of Agricultural Engineering, Alberta University, Edmonton, Alberta

P. G. Brannigan and J. B. McQuitty
Canadian Agricultural Engineering, Vol. 13, p. 69-75, December, 1971, 8 fig., 3 tab., 15 ref.

Descriptors: *Ventilation, *Gases, *Air pollution, *Distribution patterns, *Model studies, *Waste storage, *Liquid wastes, Temperature, Carbon dioxide, Ammonia
Identifiers: *Piggery, *Swine

"This study investigated the effects of ventilation on the mean concentrations and the distribution patterns of atmospheric ammonia and carbon dioxide in an enclosed chamber representing a full scale section of a pig barn. Results showed no practical differences between the distribution patterns of ammonia and carbon dioxide. Ventilation rate was the only independent variable of importance in determining the concentrations of either gas. Under non-isothermal conditions, ventilation outlet height has a negligible effect on gas concentrations. An increase in gas concentrations from stock in the diffusion of gases in the atmosphere was apparent." (McQuitty & Barber-Alberta University)

## 2201-A6, B2, E1

### HOW ARE LAGOONS WORKING ON HOG FARMS?

Illinois Department of Public Health, Division of Sanitary Engineering, Room 616, State Office Building, Springfield
C. E. Clark
Presented at 1964 Annual Meeting, American Society of Agricultural Engineering, Ft. Collins, Colorado, June 21-24, 1964, Paper No. 64-419, 12 p. 1 fig., 2 tab.

Descriptors: *Lagoons, *Design, *Waste disposal, Confinement pens, Illinois
Identifiers: *Swine, *Odor control, Flushing, Sievers System

Confinement hog feeding is a new mass production technique in agriculture. Complaints of odors and problems with waste disposal systems led the Illinois Department of Public Health to visit a few installations. This resulted in a survey of existing installations in which two major designs of waste disposal coupled with confinement methods were found. The Sievers System holds 200 hogs in one pen. The rectangular slab is sloped to a center trough on the long axis and a large part of the slab is flooded to a depth of a foot at the edge of the trough. The second type is an enclosed building broken down into smaller pens. The floor is slotted and underlain by a slab that is a concrete channel for flushing the waste to a lagoon. The study concluded that lagooning of hog waste is practical. Other methods do not appear to be economically feasible although they may be functional from the viewpoint of waste disposal. Design and maintenance of the confinement area should be considered in odor control since they are major factors. (Kehl-East Central)

## 2202-A11,B2,B4,D3,E1,F1

### NO PEN CLEANING COSTS!

J. Fetterolf
Beef, Vol. 11, No. 2, p. 16-18, October, 1974, 2 fig.

Descriptors: *Confinement pens, Cattle, *Kansas, *Waste disposal, *Lagoons, Economics, Performance

A Kansas feeder described his 2700-head confinement feeding facilities which he estimates will save $6500 a year in manure hauling. The facility has two slat sections through each of 12 pens and there are scrapers below the slats to clean the barn. The manure is pumped from the collection pit to a four-pond system, consisting of two primary and two secondary lagoons. This aerobic lagoon system handles itself except for periodic clean-outs. Only direct rainfall can get into the ponds because dike tops are above ground level. Other advantages of this type of confinement feeding include: (1) a one percent increase in yield of carcass weight, (2) feed savings due to no loss from storms or rains, (3) savings in veterinary costs, (4) the shelter will provide added warmth in winter and will allow an increase in feed utilization for finishing rather than in providing body heat for the animal, and (5) feed conversion and gain efficiencies should be better. (Merryman-East Central)

## 2203-A4,A6,A10,A12,B2,F2

### NUISANCE LAWSUITS — NEIGHBOR VS. NEIGHBOR

Successful Farming, Vol. 72, No. 10, p. 40, September, 1974.

Descriptors: *Legal aspects, *Waste treatment, *Waste disposal, Locating
Identifiers: *Nuisance lawsuits, *Bower vs. Hog Builders, Inc., *Pollution

Even if a livestock operation is not large enough for a permit to be required, the operation can still get into trouble concerning animal waste disposal. If a nuisance (the use of land by one that unreasonably interferes with the enjoyment or use of another's land) is created, a nuisance lawsuit may be brought against the operator. An example of this is the Bower vs. Hog Builders, Inc. case. In this instance, the Hog Builders, Inc. began a swine breeding and feeding operation adjoining the Bower Farm fifteen years after the Bowers had established their farm. This swine operation allowed effluent to flow onto the Bower's farm causing fish kills, odor, a difference in drinking water, and an influx of rats and flies. The Bowers lawsuit was submitted to a jury, and the Bowers were awarded $46,200 actual damages and $90,000 punitive damages. Such lawsuits can be avoided by locating such operations away from others' homes, by proper zoning, through licensing laws, and through construction of adequate waste treatment facilities. (Merryman-East Central)

## 2204-A7, B2, C2, C3

### AIR POLLUTANTS IN SWINE BUILDINGS WITH FLUID WASTE HANDLING

Agricultural Engineering Department, Illinois University, Urbana
D. L. Lebeda, D. L. Day and I. Hayakawa
Presented at 1964 Winter Meeting, American Society of Agricultural Engineers, New Orleans, Louisiana, December 8-11, 1964, 17 p. 14 fig., 5 tab., 15 ref.

Descriptors: *Air pollution, *Liquid wastes, Ammonia, Hydrogen sulfide, Carbon dioxide, Ventilation, Dimensional analysis
Identifiers: *Swine, Sulfur dioxide, Concentrations

One area of swine environment that has received little attention is air pollution caused by gaseous pollutions: Two main objectives of the study were: (1) Determine the concentrations of ammonia, hydrogen sulfide, carbon dioxide, sulfur dioxide, and air-borne bacteria in a swine confinement building with a fluid waste-handling system, and (2) Relate the concentration of gases to the management, ventilation, and building parameters of the building. The relationship of the air pollutants to the various pertinent quantities was described by dimensional analysis. A pair of totally slotted-floor pens with a common manure pit made up the unit. The volatile solids and the BOD of the swine waste collected in the manure pit were much lower than those found by Spillman. The initial addition of water to the manure pit was the main difference in the characteristic tests with swine waste. Therefore, more breakdown from oxidation and anaerobic decomposition was included in the lower loading rate due to dilution. The threshold level for humans was not exceeded by any of the gas concentrations. The study showed, however, that without ventilation, in six hours the gas concentrations in the experimental unit were three times the two-week values with ventilation for hydrogen sulfide and ammonia and six times the value for carbon dioxide. (Kehl-East Central)

## 2205-A1, A6, B2, D3, E3

### THE AMELIORATION OF ODOUR AND SOCIAL BEHAVIOR IN, TOGETHER WITH THE POLLUTION REDUCTION FROM, A HOG HOUSE WITH RECYCLED WASTES

Agricultural Engineering Department, Iowa State University
R. J. Smith and T. E. Hazen
Presented at 69th Annual Meeting, American Society of Agricultural Engineers, Saskatoon, Saskatchewan, June 27-30, 1967, 19 p. 6 fig., 4 tab., 7 ref.

Descriptors: *Odor, *Social behavior (animal)
Identifiers: *Swine, Flushing, Anaerobic lagoon, Oxidation ditch, Waste management, Waste water reuse

Although confinement housing for finishing swine has brought many benefits, it has been found that certain new problems, specific to the system, have arisen. This study performed at Iowa State University covered three areas: (1) Odour level, (2) Social behaviour of the animal and (3) Waste management. The primary objectives of the study were (1) to establish the equipment which would allow the safe reuse of the treated waste water as the fresh manure transport vehicle, (2) the change in odour level and social behaviour and (3) to measure the properties of the fluid circulating round the system. The total scheme performance has proved satisfactory during the first six weeks of operation. A high quality effluent entirely suitable for utilization of the manure transport vehicle was provided by the combination of an anaerobic lagoon with an oxidation ditch. The odour level was appreciably lowered by the rapid manure transport from the building. The system of flushing at hourly intervals not only reduced the daily liquid flow through the pighouse but it also provided a source of interest for the pigs. Social behaviour was materially improved by this distraction. (Kehl-East Central)

## 2206-A5, A8, B2, C2, E2

### PRINCIPLES OF NUTRIENT CONTROL FOR AGRICULTURAL WASTEWATERS

Professor of Civil and Agricultural Engineering, Cornell University, Ithaca, New York
R. C. Loehr
Presented at Second National Symposium on Food Processing Wastes, Denver, Colorado, March 23-26, 1971, p. 605-615, 13 ref.

Descriptors: *Nutrients, *Control, *Waste water (pollution), Agriculture, Water pollution, Recycling
Identifiers: *Land disposal

Control of nutrients in agricultural discharges will become important in the near future as the nation's water resource policies receive greater scrutiny. Better data is needed concerning nutrient concentrations being discharged and processes that can be utilized for their control. Then technical decisions and cost estimates can be made. Among pollutant sources of concern are fruit and vegetable processing wastes; meat, poultry, and fish processing wastes, and animal manures. Pollution problems caused by nutrients in wastewater discharges include: (1) additional oxygen demand caused by reduced nitrogen compounds, (2) stimulation of aquatic plant growth caused by nitrogen, phosphorus, and other nutrients in wastewater, and (3) excess nitrates in groundwater as a result of wastes discharged on land. The two most feasible approaches for nutrient control are separation at the source, recovery, and recycle and land disposal. The success of recovery and recycle depends upon the use of the product; success of land disposal depends upon better knowledge of the land as a disposal media. (Merryman-East Central)

## 2207-B3, D3, E3, E4, F1

### DIGESTION BY-PRODUCT MAY GIVE ANSWER TO ENERGY PROBLEM

Director of Environmental and Sanitary Engineering, Knoerle, Bender, Stone & Associates, Chicago, Illinois
J. Goeppner and D. E. Hasselmann
Water and Wastes Engineering, Vol. 11, No. 4, p. 30-35, April 1974. 6 fig., 2 tab.

Descriptors: *Energy, *Anaerobic digestion, *Methane, *Costs, *Recycling

Methane gas which is produced during the anaerobic digestion of sludge may be an answer to the energy problem. The volume of methane gas in anaerobic digestion is dependent upon the nature and volume of the fermentable wastes. Figures for methane production from sewage solids and garbage are given. The gas produced in general by anaerobic fermentation usually contains 60 percent to 70 percent BTU per cubic foot. Any favorable economics for using digestion units as an energy source are closely tied to the plant construction costs. The construction costs of anaerobic digesters and the operating and maintenance (O&M) costs associated with sludge digesters are dependent on size. Comparison of costs of such a method with other energy sources can be generated if a population of one million can be assumed. Such a comparison is given. A discussion considering animal wastes for such energy production is given. The Mechaelis-Menton kinetic model is used for aiming at a quantitative kinetic description of the process The importance of considering the location in relation to economics is stressed. Costs and gas value are discussed. Indications are that energy production from animal wastes is within the realm of economic reality. The need for more studies to be done and the importance of predicting the efficiency of the system are examined. (Kehl-East Central)

### 2208-A2, A8, B2, C2, E2
### USE OF CATTLE FEEDLOT RUNOFF IN CROP PRODUCTION

Kansas State University, Manhattan 66506
W. Wallington, L. S. Murphy, W. L. Powers, H. L. Manges, and A. Schmid
Report No. 1427, Kansas Agricultural Experiment Station, Manhattan 66506, p. 273-294. 11 fig., 3 tab., 10 ref.

Descriptors: *Feedlots, *Cattle, *Agricultural runoff, *Crop response, *Nutrients, Sampling, Kansas
Identifiers: Yield

Land disposal of beef-feedlot-lagoon (runoff) water was studied. Lagoon water was applied during the summers of 1970, 1971, 1972 and 1973 by furrow irrigation to a silty clay loam soil. After four years the five treatments averaged 0, 7, 13, 22 and 37 cm/yr. Corn (Zea mays L.) forage yield and plant content of N, P, K, Ca, Mg, and Na were measured. Surface soil samples and soil cores were taken from the plots after harvest each year. Electrical conductivity ranged from 1.6 to 7.6 (3.1 average) mmho/cm in the lagoon water applied at the study site and from 1.0 to 12.8 mmho/cm in samples taken from 12 Kansas feedlots. Electrical conductivitites of extracts from saturated pastes of the surface soil samples were increased linearly by accumulative treatment all years. The 1970, 1971 and 1972 soil cores showed accumulation of $NO_3$-N, P, K, and Na in the top 30 cm at all treatment rates. Movement of $NO_3$-N and Na down to 100 cm was noted in 1971 in cores from plots receiving 43 cm/yr3. Movement of $NO_3$-N down to 240 cm was recorded in 1972 in cores from plots that had received 20 and 41 cm/yr. Extractable Ca and Mg in the soil cores was not affected by treatment. Corn forage yields were a linear function of treatment in 1970 and a quadratic function in 1971, 1972, and 1973. The positive effect on yield was attributed to increased soil fertility; the relative decreases at the higher rates were attributed to increased soil salinity. Maximum yield and uptake of N and P were reached at the 13 cm/yr. disposal rate in 1971 and 1972, and at the 22 cm/yr. rate in 1973. (Wallingford, et al-Kansas State University)

### 2209-A4,B1,E1,E2,F1,F2
### AGRICULTURAL WASTE MANAGEMENT

Department of Agricultural Engineering, Oregon State University, Corvallis
J. R. Miner
Journal of the Environmental Engineering Division (Proceedings of ASCE), Vol. 100, No. EE2, February, 1974.

Descriptors: *Waste treatment, *Waste disposal, *Regulation, *Water pollution
Identifiers: *Waste management, *Pollution control, *Point sources, *Nonpoint sources, *Diffuse sources, *Land disposal

The sale price of agricultural products is established by a complex balance of supply and demand interacting with public needs and desires. This complex economic situation, plus the diverse climatic environments under which agriculture operates, creates a series of economic advantages and liabilities for feedlot operators. The design of waste management systems, to be economically feasible and technically effective, must be based on an appreciation of these factors. The principal functions involved in an agricultural waste management scheme generally include a collective system, a transport mechanism, a storage and treatment complex, and some means for ultimate reuse or disposal The management of animal wastes must be geared to these functions. Application of wastes to cropland is the most widely practical disposal method. Hence, treatment is usually for the purpose of making the manure more amenable to cropland application or for the purpose of changing its physical and chemical characteristics to avoid application difficulties or nuisances attributable to the application. (Merryman-East Central)

### 2210-A2, B1, B4, F1, F2
### STEP-BY-STEP PLAN FOR LIVESTOCK WASTE CONTROL

W. Graves
Wallaces Farmer, Vol. 97, No. 4, p. 16-17, February 26, 1972.

Descriptors: *Livestock, *Iowa, *Feedlots, Regulation, Construction, Waste storage
Identifiers: *Waste management, Runoff control

The installation of a new livestock confinement setup or feedlot involves a farmer with a bewildering array of State and Federal agencies if his final construction is going to comply with regulations. In the State of Iowa, the first step is the extension service and perhaps the area livestock specialist. Iowa State University may also be able to help. The addresses of all these agencies and the sources of recommended pamphlets are provided in the text. The next step is to investigate water sources and possible pollution problems with the help of the Iowa Geological Survey. Then the Soil Conservation Service district office will provide the technical assistance necessary to draw up specific plans on locating and building runoff controls and waste storage facilities. Cost-sharing money is available from the Rural Environmental Assistance Program. Final plans and the finished installation must both be approved by the State Department of Health before cost-sharing money is paid. (Solid Waste Information Retrieval System)

### 2211-A2,A4,A5,B2,D1,E2
### TEST WAYS TO REDUCE FEEDLOT POLLUTION

Wallaces Farmer, Vol. 97, No. 8, p. 50, April, 1972.

Descriptors: *Feedlots, *Water pollution, *Groundwater pollution, *Agricultural runoff, *Slopes, *Management, *Sampling, *Basin, Nebraska, Engineering, Caissons

Management systems designed to limit runoff, handling of manure, and consequently pollution of streams and groundwater have been constructed and are under observation. These are new concepts of inexpensive runoff control from sloping feedlots. Cattle feedlots on slopes as high as 15% may become minimum polluters through the use of engineering and management. A feedlot near Omaha, Nebraska (on a steep 15% slope with one 350 ft. contributing slope length above the lone basin) and another near Springfield, Nebraska (with 2 basins on a 6% slope, with contributing slope length of about 120 ft. each) were studied. Soil and manure materials carried with the runoff were deposited in basins. Basins provided opportunity for the settling of suspended solids. Water from the ponds were used to irrigate nearby croplands. Runoff - recording equipment and groundwater sampling wells were installed on both lots. At Springfield, none of the groundwater samples have exceeded 10 parts per million of nitrate-nitrogen a figure the Public Health Service has set as minimum desirable limit in drinking water. (Cameron-East Central)

### 2212-A2, B2, B4
### HYDROLOGY OF ANIMAL WASTE WATER PONDS

A. W. Wieczorek
Unpublished MS Thesis, Agricultural Engineering Department, North Dakota State University, Fargo, 1973, 43 p. 12 fig., 10 tab., 19 ref.

Descriptors: *Waste water (pollution), *Ponds, *Hydrology, *Design criteria, *Evaporation, Cattle, Confinement pens, Precipitation (atmospheric), Liquid wastes, North Dakato, Agricultural runoff
Identifiers: *Animal wastes

Research was developed to obtain basic data needed to design systems that utilize solar energy to vaporize the liquid wastes from storage ponds. Reported in this paper are the results of an investigation conducted to determine a "pan coefficient" for the evaporation of animal waste waters. In addition, design criteria for evaporation ponds for the disposal of animal wastes are developed and evaluated. Climatological data for the past six years indicates that pan evaporation exceeds precipitation by 2.5 times per year. Design criteria for an evaporation pond based upon this study can be determined by using the following data: (1) drained liquid wastes production from a gravity flow system utilized in a confinement barn equals 0.0026 gallon per day per pound of beef feeder, (2) a Class A pan coefficient of 0.71 to 0.75 should be applied to obtain an accurate approximation of liquid waste evaporation, and (3) a factor of 1.7 times the annual rainfall to determine pond depth increase due to bank runoff. (Cameron-East Central)

### 2213-B1, D3, E3, F1
### METHANE PRODUCTION FROM ANAEROBIC DIGESTION OF ANIMAL WASTES

Waterloo University, Waterloo, Ontario, Canada
W. D. Costigane, D. H. Edwards, D. A. Fraipont, G. R. McClean, J. H. Pinchin, and B. H. Younger
Project Report, University of Waterloo, Ontario, March, 1972, 105 p. 8 fig., 24 tab., 60 ref.

Descriptors: *Methane, *Animal wastes, *Anaerobic digestion, *Fuels, Sludge, Design, Costs

The purpose of this report is to investigate the nature and magnitude of environmental pollution from farm animal wastes and to design an anaerobic digestion system that stabilizes the waste, thereby reducing its pollutional effect. The destruction of pathogenic organisms and the production of usable products such as a combustible gas and a stable innocuous sludge are ancillary benefits achieved from the process. The anaerobic digestion system proposed in this report was designed to meet the following requirements: low capital cost, minimum maintenance and supervision and optimum waste stabilization and gas production. The total capital cost for the treatment system is $14,400. The sludge gas produced can be utilized as a fuel for heating, appliances and for running an automobile or tractor on the farm. The fuel savings obtained by the use of this gas can be applied against the cost of operating the waste treatment system. It has been estimated that a savings of $600 per year can be realized exclusive of depreciation on equipment. The anaerobic digestion system described in this report is not, at present, considered feasible for animal waste treatment on a small farm due to the high initial equipment cost. (Costigane, et. al.-University of Waterloo)

### 2214-B2, B4, E2, F1

### LOW COST MANURE BASINS WORK IN WISCONSIN

R. E. Graves
Hoard's Dairyman, Vol. 120, No. 5, p. 290-292, March 10, 1975. 6 fig., 7 tab.

Descriptors: *Waste storage, *Wisconsin, *Basins, *Cost, *Dairy industry

Earthen storage basins or ponds for storing "liquid manure" are gaining popularity with Wisconsin dairymen. These basins allow long term storage with moderate to low investment. One-year storage allows manure spreading in late summer or fall on land which is to be plowed in the fall. This saves time during busy spring planting activities. It also provides a chance for freezing and thawing during winter to lessen the effects of soil compaction from the spreading operation. There are three basic types of storage basins. Type 1 is a rectangular with one long vertical wall which is usually concrete. It has an 8 to 10 foot paved strip along the bottom of the wall. A standard liquid manure pump may be used at any point along this wall. The remaining sides and most of the bottom are earthen. This is the most expensive type to build. Type 2 is a circular- or rectangular-shaped earthen storage with one or more pumping platforms or docks. Agitation and pumping may be done by a conventional liquid manure pump from platforms. Type 3 may be a circular- or rectangular-shaped with one or more ramps or driveways into them. Agitation and pumping is done with a modified liquid manure pumo which doesn't have a right-angle gear box and is mounted horizontally from the three-point hitch of a tractor. (Merryman-East Central)

### 2215-B2, B3, B4, F1

### A COMPARISON OF SOLID AND LIQUID MANURE STORAGE SYSTEMS

Agricultural Engineering Department, Wisconsin University, Madison
C. O. Cramer, J. C. Converse, G. H. Tenpas, D. A. Schlough, R. J. Johannes, et. al.
Technical Completion Report, Project 72-14-100-10, 000-(42) USDA, ARS, 40 p., 14 fig., 13 tab., 8 ref.

Descriptors: *Waste storage, *Solid wastes, *Liquid wastes, Wisconsin, Cattle, Costs, Dairy industry
Identifiers: *Semi-solid wastes

This report is a summary of the work at the University of Wisconsin—Madison over the last few years on the three types of storages: solid storage, semi-solid storage, and liquid storage. The size of the storage depends on the number of days of storage, the number and size of animals, the type of manure, and the type and amount of bedding used. The types of solid storage systems described in detail include: bunker type storage, elevator type platform storage, thrower type platform storage, and summer time stacking. A number of storage designs have been built to handle semi-solid manure. Some units have been constructed below ground using sloping side walls with a ramp to remove it with a front end loader. The floor and walls are concrete. Others have been built above ground with side walls on all sides except for an opening with the floor sloping away from the opening. The types of liquid storage system described in detail include: free stall barn, slotted floor with underbarn tank, and manure scrape with outside storage. (Cartmell-East Central)

### 2216-A6, B1, B5, C2

### CHEMICAL OXYGEN DEMAND AS A NUMERICAL MEASURE OF ODOR LEVEL

Minnesota University, St. Paul
J. D. Frus, T. E. Hazen and J. R. Miner
Presented at the 1969 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 9-12, 1969, Paper No. 69-429, 17 p., 5 fig., 6 tab., 8 ref.

Descriptors: *Chemical oxygen demand, *Gases, Ventilation, Temperature, Humidity
Identifiers: *Odor measurement, *Swine

The specific objectives of this project were: (1) To determine if the chemical oxygen demand (COD) technique could be used as a quantitative measure of the level of organic gases present in a confinement swine building atmosphere. (2) If successful, then to determine if the level of organic gases could be correlated with observed odor level, period of time animals are in the building, air temperature, relative humidity, rate of dilution by ventilation air, or characteristics of the waste. A satisfactory technique was developed to measure the COD of the atmosphere in a confinement swine building. Determination of what the air COD value included was not conclusive. The results indicated that COD values did not increase with the time the animals were in the building and there was no correlation between air COD and manure temperature, manure COD, air temperature, or relative humidity. There was an accumulation of organic gases within the chamber when essentially no dilution by ventilation air existed. Gases known to contribute to swine odor were shown to be oxidized by the potassium dichromate. (Cartmell-East Central)

### 2217-A11, B1, C2, E3

### COMPARISON OF SOYBEAN MEAL, UREA AND DRIED CHICKEN MANURE AS PROTEIN SOURCES FOR GROWING CALVES

Minnesota University, St. Paul, Minnesota 55101
E. P. Cooper, R. D. Goodrich and J. C. Meiske
1974 Research Report B-204, P. 72-75. 3 tab.

Descriptors: *Feeds, *Proteins, *Performance, *Cattle, Ureas, Calcium, Phosphorus, Nitrogen, Nutrients
Identifiers: *Dried poultry wastes, *Soybean meal, Vitamin A

A feeding trial was conducted to compare rates of gain and feed efficiencies of growing heifer calves fed protein supplements that contained soybean meal, urea or dried chicken manure. The supplements were formulated to provide equal amounts of crude protein, vitamin A and trace mineralized salt and adequate amounts of calcium and phosphorus when fed at a rate of 3 lb. per day with a full feed of corn silage. Heifers that were fed soybean meal consumed the least amount of feed per day and per pound of gain; while those fed the chicken manure supplement consumed the most feed per day and per pound gain. Because the cattle fed chicken manure gained as well as those fed soybean meal or urea, it appears that the chicken manure used in this study provided adequate supplemental nitrogen to meet the needs of the heifers. Since amounts of feed per 100 lb. of gain were increased and the calculated TDN value was relatively low, it seems that chicken manure would be best used to provide supplemental nitrogen and not serve as a replacement for the grain portion of the ration. (Cartmell-East Central)

### 2218-A6, A10, B3, B4, C2, F1

### DESIGN OF SOLID MANURE STORAGE FOR DAIRY HERDS

Agricultural Engineering Department, Wisconsin University, Madison
C. O. Cramer, J. C. Converse, G. H. Tenpas, D. A. Schlough
Transactions of the ASAE, Vol. 16, No. 2, p. 354-360, March-April, 1973. 3 fig., 10 tab., 11 ref.

Descriptors: *Design, *Waste storage, *Solid wastes, *Dairy industry, Nutrients, Odor, Sampling, Chemical analysis, Seepage, Costs
Identifiers: Fly breeding

A bunker type manure storage for a 32-cow stanchion dairy barn in northern Wisconsin was developed and studied as to its pollution potential, the preservation of plant nutrients and the management of the system. The manure handling facility consisted of an extension to the barn cleaner elevator, horizontal distributing conveyors, and a 3,000 cu. ft. retention pond. Floor drains were constructed to allow the liquids to seep into a sampling tank and retention pond for storage. Volume measurements were made on manure production, including bedding, stored volume and seepage. Laboratory analysis was made on fresh manure, stored manure, and seepage. The average total solids concentration of the fresh manure was 13 and 14 percent while the average COD concentration was approximately 123,000 and 149,000 ppm. The average total solids concentration of the stored manure was approximately 22 and 25 percent and the average COD concentration was approximately 222,000 and 231,000 ppm. The average concentration of total nitrogen ammonia, total phosphorous, and potassium was in the area of 5,500, 1,800, 1,500, and 4,800 ppm respectively. The total seepage collected, which included urine and precipitation, was 2.0 and 4.0 gal. per cow for the winter periods. The average BOD, COD, and total solids concentration for seepage in the winter periods was 13,000 mg per 1, 31,500 mg per 1, and 2.8 percent respectively. Odors from the storage were noticed at the residence only on damp overcast days when the wind blew toward it. Fly breeding was not a problem. (Cartmell-East Central)

### 2219-A11,B1,C2,D3,E3

### DIGESTIBILITY OF CATTLE FEEDLOT WASTE

Animal Science Department, Texas Tech University, Lubbock
R. C. Albin and L. B. Sherrod
Research Report No. 24, Texas Tech University Center at Amarillo, Pantex, Texas, March, 1974. 1 tab., 7 ref.

Descriptors: *Animal wastes, Cattle, Feedlots, Nutrients, Proteins, Composting
Identifiers: *Digestibility, *Refeeding

This project was conducted to determine the nutritive value of feedlot waste taken from Southwestern cattle feedlots where improved grain processing techniques and low levels of roughage are being used. Rations containing feedlot waste were offered to feeder steers in three total collection digestion trials. The steers were checked daily for health and stress symptoms. The results suggest that when feedlot waste is fed in high concentrate-adequate protein rations, little difference would be expected between raw and composted waste. The data also indicate that when the same waste is fed in a low energy-low protein ration, the waste would be digested to a greater degree than when fed with the high energy ration. Composting would decrease the digestibility of crude protein, but would increase cell wall digestibility in low energy-low protein rations. Data indicate that recycling cattle feedlot waste would not appreciably improve the problems of cattle waste disposal. There were no problems with feed consumption. The steers readily consumed even the 60% waste rations. No animal health problems were observed. (Cartmell-East Central)

### 2220-A4, C3

### SAMPLING BACTERIA IN A MOUNTAIN STREAM

Colorado State University, Fort Collins, Colorado
S. H. Kunkle and J. R. Meiman

Colorado State University Hydrology Paper No. 28, 27 p., March, 1968, 25 fig.,14 tabs., 13 ref.

Descriptors: *Sampling, *Bacteria, *Indicators, *Water pollution, *Waste, *Coliforms, *Streptococcus, *Bioindicators, Water pollution sources, Hydrographs, Statistical methods, Temperature, Cattle, Land use
Identifiers: *Water pollution indicators, Insolation, Parameters measured, Graphical plots, Variation coefficients

Pollution-indicating bacteria groups — the coliforms, fecal coliforms, and fecal streptococci —were used to investigate bacteria fluctuations and concentrations below and above a pollution source in a small high-elevation stream in the Colorado Rocky Mountains, 1966-67. The upper of 2 sites sampled was streamflow from an uninhabited forested area, while the lower (1.5 mi. downstream) was below a grazed meadow irrigated by the creek. Statistical analysis showed that analytical error is an important source of variation with a coefficient of 0.5 in coliform replicates from one bottle, that there was more day-to-day variation than within a day, and that variability was highest at lowest concentrations. Bacteria counts showed a daily cycle with highest counts in the evening, lowest in the afternoon, and intermediate morning values. Seasonally, the spring high stage had the highest counts at the lower site while counts were highest at low flows at the upper site. The cattle-influenced site always had higher counts than the upper site. Water temperature was inversely related to concentration. Insolation rapidly killed bacteria. Coliform to streptococci ratio was less than 1.0 at the upper site and ranged from 1.70 to 5.45 at the lower. (Kunkle, Meiman-Colorado State University)

### 2221-A2,B2,B3,B4,E1,E2
### WASTE CONTROL ALTERNATIVES

Agricultural Engineer, U. S. Department of Agriculture, Nebraska University
C. B. Gilbertson
Proceedings, Pollution Research Symposium, Lincoln, Nebraska, May 23, 1969, p. 50-57.

Descriptors: *Agricultural runoff, *Feedlots, Lagoons, Topography, Climates, Housing, Design
Identifiers: *Waste management, Detention pond, Land disposal

Conventional outdoor feedlots are confronted with two basic problems. One is the handling of solids on the feedlot surface, and the other is the control of runoff. Waste control alternatives for solids handling are: (1) remove manure after each cattle cycle, (2) intermittent cleaning of critical areas, and (3) stockpile manure. Control design of a facility and management scheme must fit existing enterprises and consist of an area to detain solids and a pond to detain the liquid. Individual design based on information from a topographic map of the feedlot area, management alternatives for runoff disposal, such as irrigation, land disposal or direct release into the environment must be completed. In the production of beef, several alternatives must be considered: (1) conventional outdoor, unsurfaced lots on slopes up to 10 percent; (2) surfaced outdoor lots, "cold housed" and "hot housed" confinement. Specific conditions coupled with the feedlot operator's judgement will determine the type of operation he will have. (Battles-East Central)

### 2222-A8, B1, C1, E2
### COMPARATIVE CHANGES IN SOIL-PHYSICAL PROPERTIES INDUCED BY ADMIXTURES OF MANURES FROM VARIOUS DOMESTIC ANIMALS

California University, Davis
A. A. R. Hafez
Soil Science, Vol. 118, No. 1, p. 53-59, July, 1974. 1 fig., 7 tab., 9 ref.

Descriptors: *Soils, *Physical properties, Cattle, Poultry, Hydraulic conductivity
Identifiers: *Manure, Horses, Water holding capacity, Compactibility, Modulus of rupture

The objective of this study was to compare, by laboratory tests, the physical properties of soils as they are altered by animal manures which in themselves have different physical properties. Organic matter improves the tillage properties of soil and alters soil structure favorably by reducing bulk density. In this experiment, each kind of animal manure progressively decreased soil bulk density as the rates of applied manure increased. Increases in water-holding capacity were definitely induced by manure additions to soil and the increases were functions both of the quantity and type of manure added. There was a pronounced hydraulic conductivity improvement factor present in beef cattle and horse manures but very little in the chicken manure application. Manure applications at a rate of 5 percent favorably increased the soil shrinkage limit. Addition of animal manure to clay soil decreased compactibility. Also, dairy and beef cattle manures were more effective than chicken manure in decreasing the bulk density of compacted soil, whether at low or high soil-water contents. The soil strength as indicated by the modulus of rupture when different types and rates of animal manures were mixed with clay were reduced. The fibrous materials in manures play a major role in altering physical properties of soils. (Cartmell-East Central)

### 2223-A6, B2, D1, D3, F1
### COMPARISON OF THE CONVENTIONAL CAGE ROTOR AND JET-AERO-MIX SYSTEMS IN OXIDATION DITCH OPERATIONS

Department of Agricultural Engineering, Cornell University, Ithaca, New York
G. M. Wong-Chong, A. C. Anthonisen, and R. C. Loehr
Water Research, Vol. 8, p. 761-768, 1974. 6 fig., 6 tab., 6 ref.

Descriptors: *Aeration, *Liquid wastes, Odor, Costs
Identifiers: *Oxidation ditch, *JAM system, *Cage rotor system

This report discusses an alternative to a cage rotor for an oxidation ditch and compares the performance of two aeration systems when used for the treatment of high strength wastes. The alternative to the cage rotor is the JAM system which achieves both mixing and aeration by pumping the mixed liquid through nozzles. Mixing is maintained by energy and momentum transfer from jet streams to the bulk liquid and the concomitant turbulence and aspirator capacity of the jet streams bring about the aeration. In a comparison of the oxygen transferability of both JAM and cage rotor systems, the two systems are reasonably comparable for the conditions tested. Because of this equality, the operating costs from an energy consumption standpoint are also about equal. From a general maintenance performance the JAM system does not have the bearings and drive belt slippage problems associated with the cage rotor. From an odor and general nuisance standpoint, the aerobic treatment unit in the enclosed controlled environment alleviated problems which occurred in the previous open-sided housing system. (Cartmell-East Central)

### 2224-A8, B2, C2, E2
### DAIRY WASTE GOES FULL CYCLE IN RESEARCH

T. B. Pratt
Sunshine State Agricultural Research Report, Vol. 17, p. 10-11, July-August, 1972. 7 fig.

Descriptors: *Dairy industry, Liquid wastes, Irrigation, Nutrients, Salts, Soil profile
Identifiers: *Land disposal

Studies on the feasibility of spraying dairy wastes over the land, including uptake of the nutrients by soil and water, yield of different crops, and movement of nutrients and salts in the soil are in their third year at Hague, Florida. (Whetstone, Parker, & Wells-Texas Tech University)

### 2225-B2, B4, C1, D1, F6
### AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF BAFFLES ON THE AGITATION AND REMOVAL OF MANURE SOLIDS FROM A LIQUID MANURE HOLDING TANK

F. B. Scholfield, Jr.
Unpublished MS Thesis, Department of Agricultural Engineering, University of Tennessee, Knoxville, 1969, 35 p. 11 fig., 1 tab.

Descriptors: *Baffles, *Solid wastes, *Liquid wastes, *Model studies, Cattle, Moisture, Viscosity
Identifiers: *Agitation, *Removal, *Manure, *Holding tank, *Peat moss

Laboratory models constructed to one-fifth scale of a prototype liquid manure system were investigated in order to study the effects of internal obstructions in a model manure holding tank. The agitation nozzle, baffles, and pumping rates were also modeled. Peat moss was used to simulate scaled cow manure. The tests were run with four different baffle arrangements: (1) no baffles, (2) center baffles, (3) side baffles, and (4) side and center baffles. The following conclusions were drawn: (1) the use of the three baffle arrangements decreased the amount of solids left in the tank, and (2) the geometric placement of the agitator nozzle in this study and the use of baffles had a favorable effect on slurry agitation. Based on the volume of solids buildup above a slurry base level of 1.5 inches, these tests showed that a significant difference in the removal of settled solids existed between each of the four treatments. (Cameron-East Central)

### 2226-A11, B1, C2
### INFLUENCE OF LOW LEVEL HANDLING STRESS ON NITROGEN EXCRETION OF BLUEGILL SUNFISH (LEPOMIS MACHROCHIRUS RAFINESQUE)

Biology Department, Loyola University of Chicago, Illinois
J. Savitz
Transactions of the American Fisheries Society, Vol. 102, No. 3, p. 629-630, July, 1973. 1 fig., 9 ref.

Descriptors: *Stress, *Nitrogen, *Fish behavior
Identifiers: *Excretion, *Bluegill Sunfish

The study was designed to test whether minimal handling, as would occur in laboratory investigations of fish metabolism, would affect nitrogen excretion of bluegill sunfish. The study was carried out using bluegills weighing 33.9+/—1.4g (x+/—SE which were starved for one week prior to experimentation. Handling consisted of catching a fish with a dip net and placing it in a bucket of water for approximately 1 minute. Then it was caught by hand, weighed and placed in 8 liters of water in an individual covered, aerated aquarium. Total nitrogen analysis of water samples from the aquariums revealed that the handling stress was not severe enough to cause significant changes in mean nitrogen excretion rates. However, Fromm and Gillette (1968) showed that nitrogen excretion rates of goldfish can be influenced by ammonia already in the water. (Kehl-East Central)

### 2227-A2, A5, A8, B2, C2, E2, F1
### DESIGN FOR BENEFICIAL USE OF FEEDLOT RUNOFF

L. R. Shuyler
MS Thesis, Department of Agricultural Engineering, Kansas State University, 1969, 59 p. 9 fig., 10 tab., 16 ref.

Descriptors: *Design, Agricultural runoff, *Feedlots, Costs, Rainfall, Irrigation

The purpose of this report was to investigate one method of disposal of liquid waste from a feedlot operation. It dealt with only the disposal of the liquid waste generated in the form of runoff caused by rainfall. It was concluded that from an engineering standpoint, the disposal of waste water from feedlot drainage areas can be accomplished by using it for irrigation water on agricultural land, where land area permits. It appears safe to assume that groundwater pollution can be avoided if, in the application of waste water, no more nutrients, on the average, are added to the soil than can be removed with the cropping program. The cost of this type of disposal system is quite small when expressed on a per animal basis, considering the total annual capacity of the feedlot. (Cartmell-East Central)

## 2228-A2, A8, B2, B4, F6

### ANNUAL TOTALS AND TEMPORAL DISTRIBUTION OF CATTLE FEEDLOT RUNOFF IN KANSAS

Agricultural Engineering Department, Minnesota University
F. G. Bergsrud
Master's Report, Agricultural Engineering Department, Kansas State University, 1967, 106 p. 41 fig., 3 tab., 21 ref.

Descriptors: *Agricultural runoff, *Feedlots, *Cattle, Precipitation (atmospheric), Computers, Kansas
Identifiers: *Annual totals, *Temporal distribution, Watershed factors, Hydrologic soil cover complexes

The objectives of this study were: to establish a system for determining the total annual runoff, the inflow rates, and the temporal distribution of runoff from cattle feedlots; to analyze data using this system; and to examine the data to determine the range and distribution of occurrances using the system. The factors affecting runoff were precipitation factors and watershed factors. Data from twelve stations in Kansas were analyzed by computer for a period of thirty years. A summary of data described in the station data section is given. It was concluded that a computer can be successfully used with weather tapes to obtain runoff data from feedlots. The analyses of this data may prove beneficial in the design of runoff retention or storage structures. (Cartmell-East Central)

## 2229-A8, C2, E2, F6

### DEVELOPMENT OF A NITROGEN BALANCE IN A LABORATORY SOIL PROFILE WITH A HEAVY APPLICATION OF BEEF CATTLE WASTES

J. A. George
MS Thesis, Department of Agricultural Engineering, Kansas State University, 1970, 136 p. 6 fig., 10 tab., 8 ref.

Descriptors: *Animal wastes, *Cattle, *Soil profile, Feedlots, Denitrification, Sampling, Analysis
Identifiers: *Nitrogen balance

The purpose of this project was to study the nitrogen cycle as it occurs in a soil profile with a high loading rate of beef feedlot wastes. In order to study denitrification under as natural conditions as possible and in order to determine a total nitrogen balance, an apparatus which combined the total soil profile of a lysimeter, the closed gas collection system of an incubation apparatus and the soil solution sampling ability of a soil percolation apparatus was designed. The results of 13 test runs revealed few solid facts about denitrification. They did indicate that part of the apparatus had great potential and that other parts needed further development and experimentation. The gas measuring and analysis part of the unit did not produce usable data, but the water sampling produced quite good data. The soil and manure analysis data indicated that a considerable loss of nitrogen from the soil column occurred. Less than 10 percent of the total nitrogen lost from the soil was leached out in the water samples, indicating that the drawing off of water samples removes a minimum of nitrogen from the sight of active transformations. Only 2 percent of the total indicated nitrogen loss was leached out of the bottom of the 4 foot soil profile. (Cartmell-East Central)

## 2230-A8, B3, C1, C2, E2, F1

### MANURE DECREASES NEED FOR FERTILIZER

Wallaces Farmer, Vol. 97, p 6, March 25, 1972

Descriptors: *Fertilizers, *Nutrients
Identifiers: *Manure, *Tilth, *Croplands, Bedding

Under proper management, manure application to croplands provides valuable nutrients and increases soil tilth and water holding capacity. Relative values of different manures range from $2 per ton for dairy cattle to over $6 per ton for poultry. A 1000 pound beef animal will produce 10.95 tons of wet manure per year at 85% moisture. Bedding should be added in sufficient amounts to absorb the liquid and thus reduce handling difficulties. Straw, cornstalk, soft wood shavings, sawdust and peatmoss all absorb many times their weight in moisture and thus retain valuable nutrients such as nitrogen, phosphorus, and potassium. (Battles-East Central)

## 2231-A2, B2, B3, C2, D3, E2, F1

### MANURE CAN CUT YOUR FERTILIZER BILL

W. Groves
Wallaces Farmer, Vol. 97, No. 19, p. 40-41, October 14, 1972. 2 tab.

Descriptors: *Fertilizers, *Costs, *Nutrients, Nitrogen, Phosphorus, Potassium, Irrigation, Lagoons
Identifiers: *Land spreading, Oxidation ditch

A well-managed manure handling system can help trim chemical fertilizer costs. Experiments were conducted on 6 types of waste handling systems by Dale Vanderholm, Iowa State University extension agricultural engineer. The systems tested included: (1) combination oxidation ditch and anaerobic lagoon with irrigation or liquid spreading, (2) deep pit storage with liquid spreading, (3) anaerobic lagoon with liquid spreading or irrigation, (4) aerobic lagoon with irrigation or liquid spreading, (5) bedded confinement with solid spreading, (6) open lot with or without shelter; solid spreading with runoff collected and irrigated or liquid spread. System 1 showed the greatest loss of nitrogen and system 5 showed the least loss of all systems tested. At 7 cents per pound, anywhere from $5.25 to $12.95 worth of nitrogen may be lost from a 1000 lb. beef animal's excrement, depending upon the system. Vanderholm figures a 50% $P_2O_5$ loss and a 30% $K_2O$ loss in anaerobic lagoons, but no losses in other systems. Use of Vanderholm's guidelines can be of help in determining how much land is needed in spreading various types of manure. (Battles-East Central)

## 2232-A4, B2, C1, C2, C3, F2

### EPA AND THE FISH FARMER

Chairman, CFA Research Committee and the 12-State S-83 Catfish Research Committee
J. W. Avault, Jr.
The Catfish Farmer, Vol. 6, No. 4, p. 16-17, 30, July/August, 1974.

Descriptors: *Fish farming, *Regulations, *Effluent, Ponds, Suspended solids, Pollutants, Monitoring
Identifiers: *Environmental Protection Agency, Raceways, Settleable solids, Fecal coliforms

The Environmental Protection Agency held a hearing on May 23, 1974, at Athens, Georgia, to discuss proposed regulations for the effluent of ponds, raceways, and other culture systems and drafted them into a 237-page book. Fish growers are divided into three categories: (1) Native fish — flow thru culturing systems, (2) Native fish — pond culturing, and (3) Non-native fish culturing system. The proposed regulations for category 1 call for the monitoring of suspended solids, settleable solids, NH(3)—N and net concentrations of fecal coliform bacteria. Limits are placed upon each of these four items. Proposals for category 2, where most catfish farmers would fit, demands that settleable solids must not exceed 3.3 milligrams per liter and fecal coliform must not exceed 200 organisms/100 ml. The proposed regulations for category 3 calls for no discharge of process wastewater pollutants. All these regulations are concerned solely with the quality of the water as it leaves the drain pipe. Proposed regulations must be implemented by July 1, 1977, and stricter regulations must be implemented by July 1, 1983. If these proposed regulations become law on October 25, 1974, the costs of periodically checking the wastewaters and cleaning up polluted water will be borne by the farmer. The EPA breaks its suggestions for methods of cleaning up catfish ponds into: (1) water conservation; (2) feeding practices; (3) fish distribution; (4) pond draining; and (5) harvesting. (Battles-East Central)

## 2233-A11, B1, B4, B5, C2, D3

### CHARACTERISTICS AND ANAEROBIC DIGESTION OF SWINE WASTE

Spillman, C. K.
M. S. Thesis, University of Illinois, Department of Agricultural Engineering, 1963, 54 p.

Descriptors: *Farm wastes, *Hogs, *Anaerobic digestion, *Waste treatment, *Waste storage, *Waste disposal, Gases, Confinement pens, Effluent, Nitrogen, Chemical oxygen demand, Biochemical oxygen demand, Hydrogen ion concentration
Identifiers: *Swine, Loading rates, Ammonia nitrogen, Organic nitrogen, slotted floors

The objectives of this study were: (1) to study the breakdown of organic matter which occurs when swine waste is stored under slotted floors and allowed to decompose anaerobically, and (2) to determine some characteristics of swine waste which are important in the design of disposal systems. To accomplish these objectives, 12 digesters were set up and loaded with swine waste material at rates considered typical of those in use in slotted floor hog houses. The characteristics of swine waste could be determined from the results obtained from the tests on waste material. Tests were run for ammonia nitrogen, organic nitrogen, chemical oxygen demand, and biochemical oxygen demand. A design recommendation was to make the pits under slotted floors 3 to 5 feet deep. The most important aspect of pits under slotted floors is the effect on the animals of the gases produced during digestion. The gases produced and the concentration which would exist in buildings should be determined. (Cartmell-East Central)

## 2234-B1, C1, C2, D3

### AEROBIC DIGESTION OF CATTLE WASTE

Jones, D. D.
MS Thesis, Agricultural Engineering Department, Illinois University, 1967, 127 p., 38 fig., 9 tab., 21 ref.

Descriptors: *Farm wastes, *Cattle, *Waste treatment, Chemical oxygen demand, Biochemical oxygen demand, Diets, Digestion, Dairy industry, Analysis, Nitrogen, Potassium, Phosphours
Identifiers: *Aerobic digestion, *Loading rates, Volatile solids, Fixed solids.

This study was undertaken to determine the effectiveness of the aerobic digestion process in the treatment of dairy and beef cattle wastes. Wastes were collected from livestock being fed high concentrate ration. It was added in varying loading rates to laboratory aerobic digesters. For dairy cattle, a waste feed having a BOD concentration of 19,400mg/1 and a VS concentration of 50,000 mg/1 was added to digesters. Total BOD reductions of 70, 60, and 76 percent and total VS reductions of 20, 15, and 0 percent, respectively, were obtained for the loading rates of 125, 150, and 200 ml. Because of the extremely large amount of nonbiodegradable organic matter present, all three digesters may have been overloaded. Due to the settling of solids during the latter part of the feed period, no conclusions can be drawn as to the effectiveness of treatment of the optimum of loading rate. For beef cattle, a waste feed having a BOD concentration of 8,000 mg/1 and a VS concentration of 30,000 mg/1 was added to digesters. Total BOD reductions of 59, 70, and 40 percent and total VS reductions of 38, 27, and 16 percent, respectively, were obtained for the loading rates of 100, 150, and 200 ml. Optimum loading rate was determined to be 150 ml. and significant reduction of biodegradable organic concentrations was obtained. (Cartmell-East Central)

### 2235-A1,A2,A7,A8,A12,B1, C2,E2

## FATE OF NITROGEN UNDER INTENSIVE ANIMAL FEEDING

Agricultural Research Service, United States Department of Agriculture, Fort Collins, Colorado
F. G. Viets
FEDERATION PROCEEDINGS, Vol. 33, No. 5, p. 1178-1182, May, 1972. 24 ref.

Descriptors: *Nitrogen compounds, *Feedlots, Denitrification, Agricultural runoff, Ammonia
Identifiers: *Pollution, Land disposal, Amines

Among the potential nitrogenous pollutants arising from the feeding of protein and urea are microbial protein, amino acids, urea, uric acid, ammonia, and a host of complex compounds that either have not been identified or have been ignored. The amount of nitrogen available for beneficial use on growing crops depends on management and waste collection. The pathways for removing this nitrogen are manure hauling, runoff, percolation, denitrification on site, and volatilizaiton of ammonia and other basic N compounds. The source of nitrate in a shallow farm well has been considered to be drainage from septic tanks, cesspools, and barnyards, with overfertilization of crops being an insignificant contributor except on very sandy soils. Ammonia is a contaminant of all air and rain. The feedlot, as a source of ammonia, represents a great disturbance of the environment. Amines are of concern for two reasons. They are very stinky substances that are persistent in sticking to clothing and most all kinds of surfaces. Second, the secondary amines can combine with nitrite under favorable conditions to produce the highly carcinogenic, teratogenic, and mutagenic nitrosamines. (Cartmell-East Central)

### 2236-A8,B3,C2,D3,E2 ,F3

## USING POULTRY MANURE COMPOST TO RECLAIM SALT POLLUTED SOILS

Assistant Agronomist, Department of Agronomy, Arkansas University, Fayetteville 72701
L. H. Hileman
Compost Science, Vol. 15, No. 2, p. 22-23, March-April, 1974. 2 fig., 2 tab.

Descriptors: *Reclamation, *Poultry, *Grasses, Phosphorus, Calcium, Potassium, Magnesium, Conductivity
Identifiers: *Salt polluted soils, *Compost, *Excreta, pH

Brine water dumping from oil field operations, which was permitted in the past, resulted in barren land of little or no value. In 1970, Dr. H. C. Dean, State Soil Scientist, surveyed the problem in southern Arkansas. In 1971, a compost made with chicken manure was applied to a brine-polluted area to see if it would be useful in reclaiming the land. The compost was applied at a rate of 6 tons per acre and rototilled into the upper 4 inches of the soil. The land was then seeded with Japanese millet, Pangburn switchgrass, bahia, common bermuda grass, and Kobe lespedeza. The treated area was overseeded in the fall of 1971 with Kentucky-31 fescue and crimson clover. All species germinated and grew; however, the lespedeza and clover did not grow over about 3 months. The grasses survived well and grew for three years without further treatment. Tests revealed that the compost application improved soil pH, phosphorus, calcium, and sodium. There was very little change in potassium, magnesium, and conductivity. It is thus indicated that a good quality compost can be used to reclaim brine polluted land. Further experimentation is needed to determine required rates of compost. (Merryman-East Central)

### 2237-A5,A6,A10,B3,B4,D3

## COMPOSTING POULTRY MANURE IN DEEP-PITS

Extension Poultry Products Specialist, Purdue University, Lafayette, Indiana
J. G. Berry
Feedstuffs, Vol. 43, p. 32, July 3, 1971.

Descriptors: *Composting, *Poultry, *Waste storage, Odor, Rodents, Costs
Identifiers: *Deep-pit, Flies

Deep pits in operation up to six years without odors, flies, or troubles are reported. The overriding consideration is that the manure must be kept dry. Sealing of the pit to protect groundwater and to exclude rodents is desirable. Labor and operating costs can be reduced significantly by use of deep pits. Building costs will be higher and serious trouble may occur if the manure gets wet. (Whetstone, Parker, & Wells-Texas Tech University)

### 2238-A6,B2,B3,C1,D1,E2, E3,F1

## TWO-STAGE DRYING FOR MANURE DISPOSAL ADVOCATED BY PENN STATE POULTRYMAN

Feedstuffs Staff Writer
G. Lauser
Feedstuffs, Vol. 34, p. 7, 33, July 31, 1971.

Descriptors: *Drying, *Poultry, *Economics, Odor, Aeration
Identifiers: *Deep-pit storage, Refeeding, Land disposal

Glenn Bressler considers the deep pit to be the worst possible "solution" to poultry manure disposal. When the day of cleanout finally arrives, the sticky, odiferous mess will have lost its fertilizer value. Liquid handling pollutes large volumes of water with resulting higher costs for low-pollution disposal. Two-stage drying, with the first stage occurring in place and reducing the moisture content from 75 percent to 35 percent, is advocated. Cost data are cited. (Whetstone, Parker, & Wells-Texas Tech University)

### 2239-E3

## ARIZONA FEEDS HELPING IN BEEF WASTE RECLAMATION

Feedstuffs, Vol. 44, p. 5, March 6, 1972.

Descriptors: *Arizona, *Cattle, *Feeds, *Proteins
Identifiers: *Refeeding, *Waste reclamation

Arizona Feeds of Tucson is cooperating with General Electric in a project for the production of 120 lb. per day of protein for cattle feed. The source is cattle manure. (Whetstone, Parker, and Wells, Texas Tech University)

### 2240-C2, D3, E3

## GENERAL ELECTRIC TO RECYCLE BEEF MANURE INTO PROTEIN FEED AT NEW ARIZONA PLANT

Feedstuffs, Vol. 44, p. 4, April 10, 1972. 1 fig.

Descriptors: *Feeds, *Cattle, *Arizona, Thermophilic bacteria, Proteins
Identifiers: *General Electric, *Refeeding

A pilot plant at Casa Grande, Arizona, scheduled to begin production in the summer of 1972 will process the wastes from 100 cattle by providing for digestion of the waste by thermophilic bacteria followed by harvesting of the bacteria for protein. Years of research have gone into the process wherein 400 500 lb. manure (dry weight) will produce 120-150 lb. protein. Other cellulose wastes would be amenable to the same process. (Whetstone, Parker, & Wells-Texas Tech University)

### 2241-A4,B2,C1,D1,D3,E2, F1,F2,F6

## THE PERFORMANCE OF AN EXPERIMENTAL HIGH-RATE BIOLOGICAL FILTRATION TOWER WHEN TREATING A PIGGERY SLURRY

Farm Buildings and Information Division, National Institute of Agricultural Engineering, England
R. Q. Hepherd and A. H. Charlock

Descriptors: *Filtration, *Slurries, *Dewatering, Design, Suspended solids
Identifiers: *Swine, *High rate biological filtration

Waste disposal problems are being caused on many farms by the intensification of livestock enterprises and the development of housing systems in which little or no bedding material is used. Also, the discharge of slurries or other liquid from wastes into ditches, streams, rivers, etc., or (exceptionally) even on to land, without the prior approval of the authority concerned is prohibited by such Acts as the Rivers (Prevention of Pollution) Acts of 1951 and 1971, and the Water Resources Act of 1963. The objectives of this study were: (1) to provide engineering data for the design of a farm-scale experimental plant, which would allow the various aspects of the process to be examined in greater depth and (2) to investigate the performance of plastics and other lightweight filter media. Present knowledge suggests that the high-rate biofiltration type of anaerobic treatment may be an economical alternative to conventional methods of disposing of pig wastes to land. The study showed that sludge dewatering by filtration through straw may be practicable for the smaller piggery units. However, for the larger pig units and for plants treating cattle slurries, the development of mechanical dewatering equipment appears to be essential. The difficulty of controlling the solids level at dry matter loadings over about 27 kg/d was the cause for the limitation to the loading of the pilot plant. Effluent quality was normally between 300 and 800 mg/1 suspended solids and 100 and 300 mg/1 BOD and the daily volume was small (about 0.9m(3), neglecting evaporating losses, etc., which were not measured). A new and larger pilot-scale plant is presently being constructed to study in greater detail the effects of higher loading rates on plant performance, on sludge dewatering, on the incidence of blockage in various medium types, and on low-cost equipment for effluent-land application. (Kehl-East Central)

### 2242-A8, B1, C2, E2

## NITROGEN LOSS FROM MANURE AS INFLUENCED BY MOISTURE AND TEMPERATURE

Department of Soil Science, Michigan State University, East Lansing
D. C. Adriano, A. C. Chang, and R. Sharpless
Journal of Environmental Quality, Vol. 3, p. 258-261, July-September, 1974, 1 fig., 4 tab., 22 ref.

Descriptors: *Nitrogen, *Moisture, *Temperature, *Soil, *Feedlots, Nitrification
Identifiers: *Volatilization

One of the principal components in cattle wastes that requires critical attention because of its impact on environmental quality is nitrogen. The main objective of this study was to evaluate under controlled conditions, the effect of the interactions of soil temperatures with moisture on manurial-N loss. These two variables' effects no N losses from different application rates of manure were studied under greenhuose conditions at two soil temperatures (10° and 25° C) and at two soil moistures (60 and 90% of water saturation percentage, WSP). There was no significant effect on the percentage of loss applied N by manurial rate. At 10° C, the average losses of applied N for the 60 and 90% moisture levels were 26 and 39% respectively. At 25° F, higher losses for the 60 and 90% levels were 40 and 45%, respectively. It is felt that about 50% of the N from cattle manure applied to uncropped land can be lost within a few weeks through gaseous evolution largely as $NH_3$. In confined operations with paved lots or in old unpaved lots perhaps losses would even be higher. Ammonia absorption by clay minerals will be non-existent or minimal under these conditions. (Kehl-East Central)

## 2243-A6,B2,B4,D1,D3,E2

### CONFINEMENT LIVESTOCK FACILITIES WASTE MANAGEMENT CODE OF PRACTICE

Descriptors: *Canada, Alberta, Confinement pens, *Farm management, *Design, Odor, Livestock
Identifiers: *Isolation distances, Waste handling, Land application

Published under the authority of the Minister of the Environment and the Minister of Agriculture, Queen's Printer, September, 1973, 31 p. 7 fig., 4 tab.
Public concern about all forms of pollution of our environment is growing while intensive livestock operations are increasing in number and size. The number of residential dwellings on or near farmland is increasing. Developers of non-agricultural activities in agricultural areas should be aware that complete odor control is beyond present technical capabilities. These guidelines stress that when conflicts result from encroachment on agricultural areas, much of the responsibility should be accepted by the developers and not only the agricultural operator. Guidelines for confinement livestock facilities waste management intend to provide a technical base upon which livestock operators can develop without causing undue environmental impact. Administration and definitions regarding the guidelines are given. The guidelines are defined in terms of developments requiring compliance and the isolation distances. The various components of design guidelines for livestock facilities are listed and examined. The components include manure storage, earthen catch basins (and alternate methods), walled storage, storage lagoons and mechanically aerated systems. The guidelines for animal waste management, including the handling of solid and liquid manure, are discussed. Land application is also examined. Directions for the procedure for using the code are given. (Kehl-East Central)

## 2244-A11, B3, C2, D2, E3

### EFFECT OF PROCESSING METHOD ON PASTURIZATION AND NITROGEN COMPONENTS OF BROILER LITTER AND ON NITROGEN UTILIZATION BY SHEEP

Virginia Polytechnic Institute and State University, Blacksburg 24061
L. F. Caswell, J. P. Fontenot, and K. E. Webb, Jr.
Journal of Arimal Science, Vol. 40, No. 4, p. 750-759, April, 1975. 3 tab., 33 ref.

Identifiers: *Sheep, *Broiler litter, *Refeeding, *Pasturization, *Nitrogen utilization, Processing method

Experiments were conducted to determine the effect of different methods of processing broiler litter on pasturization and nitrogen components of litter, and to study the relative effects on nitrogen utilization, ration digestibility and blood and ruminal parameters when litter was fed to sheep. It was concluded that methods found to be effective pasteurization processes were: Dry heating at 150° C for 20 min., autoclaving for 10 min., dry heating at 150° C at depths of .6 or 2.5 cm with addition of paraformaldehyde, and ethylene oxide fumigation for a minimum of 30 minutes. No digestive disturbances were observed in the experimental animals. Fecal, urinary and total nitrogen excretion did not differ among treatments. Processing method did not affect the apparent digestibility of dry matter, crude protein, ether extract, crude fiber and NFE. Blood urea levels were not significantly different among treatments. Acetic acid was significantly higher for the animals fed dry heat plus PFA treated litter than for either of the other treatment groups. (Cartmell-East Central)

## 2245-A5, C2, E2

### GROUNDWATER QUALITY BENEATH A MANURE DISPOSAL AREA

Agricultural Engineering Department, Texas A&M University
D. L. Reddell
Presented at the 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 15 p. 11 tab., 15 ref.

Descriptors: *Waste disposal, *Nutrients, Nitrogen, Sodium, Chloride, Ammonium, Chemical oxygen demand
Identifiers: *Groundwater quality, *Land disposal

The objective of this research was to evaluate the effect of a very heavy application of beef manure on the groundwater quality of a manure disposal area at El Paso, Texas. It was concluded that groundwater showed increased amounts of chloride, COD, ammonium, sodium, organic-N and nitrate for a period of approximately 1 year following the manure application, but then decreased to background levels in most cases within 2 years after the application. Also, nitrates accumulated in the unsaturated soil zone above the water table during much of this study. However, they apparently denitrified upon entering the water table, because groundwater samples indicated only minor increases in $NO_3$ levels. (Cartmell-East Central)

## 2246-B1, F1, F2

### IMPACT OF ENVIRONMENTAL REGULATION ON THE LIVESTOCK INDUSTRY

Executive Vice President, National Livestock Feeders Association, Omaha, Nebraska
B. H. Jones
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, 9 p.

Descriptors: *Regulation, *Feedlots, *Costs, Livestock

A discussion of proposed guidelines and the effect they could have on the stability of rural economics, production costs, supplies of animal products, and consumer prices is given. In terms of price increases and overall industry capacity, the economic impact of the proposed effluent guidelines for feedlots would not be serious. Agriculture and business and industry have been receiving eroding blows for a period of years, but the impact of environmental regulation will fall mostly on the small operator. It is said that many of these will be forced out of business. The industry may be pushed toward the middle of the road in terms of the unit size of operation. It is important to consider that environmental control expenditure does not generate additional cash flow or new income opportunitities. Such investments are not cost-reducing or production-increasing. In fact, they are cost-creating, since they give rise to additional maintenance and other operational costs. (Cartmell-East Central)

## 2247-A1,A6,B1,D2,D3,E2,E3

### ANIMAL WASTE DISPOSAL METHODS—PRESENT AND FUTURE

E. P. Taiganides
Feedstuffs, Vol. 40, No. 37, p. 37-38, September 14, 1968, 3 tab.

Descriptors: *Animal wastes, Waste disposal, *Odor, Gases
Identifiers: *Waste management

The factors that cause or aggravate the animal producers' waste disposal problems may be grouped as follows. 1. Manure characteristics. 2. Present methods of manure handling and disposal. 3. Expansion of urban centers into rural areas plus public awareness of the need for a healthy and aesthetically pleasant atmosphere. Control of odor and odorous gases is a vexing problem for the feedlot owner. The most important gases generated within an animal confinement unit are carbon dioxide, ammonia, hydrogen sulfide, methane, and trace quantities of a host of organic compounds such as acids, mercaptans, skatols, etc. The largest single problem associated with confinement units involves manure management. Of the present methods of manure handling, the most important are anaerobic lagoons, digesters, aerobic oxidation, dehydration, coprophagy, composting, and land spreading. (Cartmell-East Central)

## 2248-A7, B1, C2, E1, E2

### IDENTIFICATION AND MEASUREMENT OF VOLATILE COMPOUNDS WITHIN A SWINE BUILDING AND MEASUREMENT OF AMMONIA EVOLUTION RATES FROM MANURE-COVERED SURFACES

Department of Agricultural Engineering, Oregon State University, Corvallis, Oregon 97331
J. R. Miner, M. D. Kelly and A. W. Anderson
Technical Paper No. 3972, Oregon Agricultural Experiment Station, 1974, 11 p. 2 fig., 3 tab., 6 ref.

Descriptors: *Organic compounds, *Measurement, *Ammonia, Nitrogen, Lagoons
Identifiers: *Swine building, *Manure - covered surfaces, *Identification

In an effort to devise a field technique for sampling and measuring airborne volatile organic compounds in the vicinity of livestock production facilities, a trapping procedure was developed. A sampling box was designed and built which permitted the measurement of ammonia generation rates from earth, building, and treatment system surfaces. These measurements qualified the rate of ammonia release from dairy and swine housing areas, manure storage facilities, and grassland used for manure disposal. In addition to the ammonia evolution, these studies indicated a non-ammonia nitrogen evolution rate ranging from 0.25 to 0.75 of the ammonia. No correlation was evident from these data between age of manure and non-ammonia nitrogen ammonia release rates. Non-ammonia nitrogen values were consistently low from the swine manure lagoon surface. (Cartmell-East Central)

## 2249-A7, C2

### IDENTIFICATION OF ALIPHATIC AMINES VOLATILIZED FROM CATTLE FEEDYARD

U. S. Department of Agriculture, Agricultural Research Service, P. O. Box E, Fort Collins, Colorado 80521
A. R. Mosier, C. E. Andre, & F. G. Viets, Jr.
Environmental Science and Technology, Vol. 7, p. 642-644, 1973. 2 fig., 2 tab., 11 ref.

Descriptors: *Feedlots, *Cattle, *Volatilization, Nitrogen compounds
Identifiers: *Aliphatic amines, *Identification, Dilute acid traps

An investigation was conducted to identify some of the basic organic N-containing compounds volatilized from a cattle feedlot. These compounds were collected in dilute acid traps. Direct gc analyses of the acid trap concentrates showed that 10 compounds could be observed. To identify these compounds the retention times of the unknown materials were compared with those of the standard aliphatic amines. Methyl, dimethyl, ethel, n-propyl, iso-propyl, n-butyl, and n-amylamines were among the basic N-compounds volatilizing from a high density cattle feedyard. (Cartmell-East Central)

### 2250-A8, C2
### CHEMICAL CHARACTERISTICS OF A FEEDLOT SOIL PROFILE
U. S. Department of Agriculture, Agricultural Research Service, Lincoln, Nebraska
G. E. Schuman & T. M. McCalla
Soil Science, Vol. 119, No. 2, p. 113-118, February, 1975. 6 fig., 2 ref.

Descriptors: **Feedlots, *Soil profiles, *Chemical properties, Nitrates, Potassium
Identifiers: *Impermeable layer

This study was made to determine the chemical composition of feedlot profiles, which might be helpful in understanding the characteristics of feedlot soil profile and the effects of the observed characteristics on the profile. The exchange complex was predominantly saturated with K in the top 15 cm of the soil profile immediately below the manure pack. Ca became the dominant ion below that depth. The high K resulted from large amounts of K in the rations fed to the livestock. The zone where high levels of K were present was also high in carbon. This zone was very dark and slightly more dense than the material above and below. The permeability of this dark layer was low. Soil columns leached with $CaCl_2$ allowed percolation to occur, which indicated that the sealing was at least partially due to the K. No percolate resulted from the distilled water of KC1 solution treatments. $NO_3$-N was very low below the impermeable layer and several fold higher in the field profile. (Cartmell - East Central)

### 2251-A8,A11,B1,C2,E2
### FERTILIZER, FEED VALUE OF SWINE WASTES DETAILED
J. D. Kendall, Editor
Feedstuffs, Vol. 47, p. 12-13, April, 1975.

Descriptors: *Recycling, *Fertilizers, *Feeds
Identifiers: *Hogs, *Feces, *Refeeding, Application rates, Performance

A summary of a paper on the value of swine waste as a fertilizer and a feed resource is presented. The composition of manure can vary and change, due to the following three factors: (1) the nutrient composition and type of ration fed to the pigs; (2) the amount of feed and water wastage and the amount of bedding used with manure, and (3) waste handling and storage methods. Some factors to consider for efficient use of swine waste on land are: method of application, time of application, soil characteristics, and crop nutrient removal. Excessive nitrogen loading, salinity problems, and accumulation of heavy metals in the soil and growing crops are probably the greatest hazards for heavy and long-term applications of waste to the soil. Swine waste is a potential feed ingredient. In past research pig feces have made up as much as 19% of a ration without any adverse effect on feed efficiency. (Cartmell-East Central)

### 2252-A8, E2
### FEEDLOT WASTE EFFECTS ON SOIL CONDITIONS AND WATER EVAPORATION
USDA Southwestern Great Plains Research Center, Bushland, Texas 79012
P. W. Unger and B. A. Stewart
Soil Science Society of America Proceedings, Vol. 38, p. 954-957, 1974. 2 fig., 1 tab., 14 ref.

Descriptors: *Feedlots, *Effects, Bulk density, Porosity, Organic Matter, Evaporation
Identifiers: *Land disposal, *Application rates, Soil water retention, Aggregation

The purpose of this study was to evaluate the effects of various feedlot waste (FLW) application rates on various soil conditions and on evaporation of water from the soil. Feedlot wastes applied at rates considered adequate to supply the nutrient requirements of plants had no significant effects on soil conditions. The effects on soil conditions were significant as FLW application rates increased. The reduced bulk density and water retention at high matric potentials of the plow layer of FLW-treated soil suggest that water from irrigation or precipitation should move more readily to greater depths in the soil where the water is less susceptible to losses by evaporation and hence conserved for subsequent plant use. An evaporation study in the laboratory with FLW treated soil revealed reduced evaporation with increased rates of FLW application. (Cartmell-East Central)

### 2253-A7, C2
### ELEMENTAL COMPOSITION OF PARTICULATES NEAR A BEEF CATTLE FEEDLOT
Department of Soils and Plant Nutrition, California University, Davis 95616
J. Azevedo, R. G. Flocchini, T. A. Cahill, P. R. Stout
Journal of Environmental Quality, Vol. 3, No. 2, p. 171-174, April-June, 1974. 3 fig., 1 ref.

Descriptors: *Dusts, *Feedlots, *Cattles
Identifiers: *Manure, *Composition, *Particulates

Dusts from manures should have characteristic elemental signatures reasonably distinct from those of dusts from surrounding soils. The flow of dust near animal corrals was examined objectively through use of alpha-excited X-rays and the origin of aerosols in the surrounding air was assessed. The contribution of large particulates from the feedlot to the atmosphere was restricted to the immediate vicinity of the corrals. The feedlot contributed very little to the concentration of intermediate-sized particles in the air, but did have some influence on the smallest-sized particles. The summation of analyzed elements in each size stage downwind to the feed mill did not exceed those upwind. Eight elements (Si, A1, P, S, C1, K, Ca, and Fe) were present in detectable quantities in the majority of the air samples taken in the vicinity of the feedlot. (Cartmell-East Central)

### 2254-B2,C1,C2,C3,D3,E1,E3
### THE ANAEROBIC DIGESTION OF WASTE FROM AN INTENSIVE PIG UNIT
Rowett Research Institute, Bucksburn, Aberdeen, AB2, 9SB
P. N. Hobson & B. G. Shaw
Water Research, Vol. 7, No. 3, p. 437-449, 1973. 1 fig., 13 tab., 14 ref.

Descriptors: *Anaerobic digestion, *Waste treatment
Identifiers: *Swine, *Loading rates

Anaerobic digestion was investigated as a primary treatment for very strong agricultural wastes, to reduce the solids and polluting properties and to improve the settling of the waste in order to give a supernatant liquid which, while not up to river board standards would be suitable for discharge to town sewers, for secondary aerobic or other treatment, or for recycling as animal house wash-water. Six experiments were run. Experiments 1 and 2 concerned batch digestion of waste. The experiments showed that a proper digestion, with the primary acidic and secondary methanogenic fermentations in balance, could not be developed by direct incubation of undiluted or almost undiluted, pig waste. Experiment 3 showed that a balanced digestion of piggery waste could be obtained using a seed of digesting sewage, but that loading rate in the early stages of the digestion could be a critical factor. Experiment 4 showed that a balanced digestion of piggery waste could be achieved without a seed if the initial loading rate was low enough to allow a methanogenic flora to develop before a high acid concentration was reached. Experiments 5 and 6 dealt with performance of initially seeded and unseeded digestions at different loading rates. These two experiments revealed that balanced digestion could be obtained by using, initially, low loading rates and allowing time for the build-up of a stable population of the correct bacteria. (Cartmell-East Central)

### 2255-A4,A5,A8,B1,C2,E2,F3
### ANIMAL WASTES AND FERTILIZERS AS POTENTIAL SOURCES OF NITRATE POLLUTION OF WATER
U. S. Department of Agriculture, Fort Collins, Colorado
F. G. Viets, Jr.
Reprint from Effects of Agricultural Production on Nitrates in Food and Water with Particular Reference to Isotope Studies, Vienna, International Atomic Energy Agency, 1974, p. 63-76, 1 tab., 32 ref.

Descriptors: *Water pollution, *Nitrates, *Animal wastes, *Fertilizers, Hydrology, Nitrification, Infiltration, Eutrophication, Agricultural runoff, Ammonia, Volitalization
Identifiers: Isotopic nitrogen

An updating and supplementing of the U. S. Department of Agriculture Handbook 413, "Factors Affecting the Accumulation of Nitrate in Soil, Water, and Plants" (Viets and Hageman, 1971) is provided. A change over from vegetable protein to animal protein in the human diet has resulted in the increased use of nitrogen fertilizer in the developed countries for the last 30 years. Stocking rate and the continuity of use of the feed-yard or holding area appear to be the factors upon which nitrate percolation to aquifers depend. Because of inhibited nitrification and infiltration, modern high-density cattle feed-yards have low nitrate flux. Eutrophication and nitrate accumulation may be contributed to by volatilization of ammonia and its absorption by surface water. Nitrate leakage occurs under highly productive cultivated land regardless of the nitrogen source. Fertilization management must hold this leakage to a tolerable concentration in relation to hydrology and use of underground water in the area. There is a need for better understanding of land productivity, nitrate leakage, and hydrology. Assistance in solving these problems may be obtained from isotopic nitrogen. (Kehl-East Central)

### 2256-A6, A7
### DIURNAL FLUCTUATION AND MOVEMENT OF ATMOSPHERIC AMMONIA AND RELATED GASES FROM DAIRIES
Western Region, Agricultural Research Service, U. S. Department of Agriculture, and the California Agricultural Experiment Station
R. E. Luebs, K. R. Davis, and A. E. Laag

Descriptors: *Ammonia, *Dairy industry, *Gases, *Air pollution, Odor
Identifiers: *Diurnal fluctuation

Ammonia has been known to be in the atmosphere for nearly 100 years. Recently, concern for environmental quality has increased interest in $NH_3$ as a potential air pollutant. It has recently been shown that the waste or manure from large concentrations of domestic animals is a significant local source of atmospheric $NH_3$. This study, consequently, had three objectives: (1) determination of the atmospheric concentrations of ammonia and related gases near dairy operations, (2) determination of the stability of these concentrations, and (3) determination of the effect of mind areal distribution and concentrations. Simultaneous 24-hour air sampling, 0.8 km upwind from the nearest cows in a large dairy area (145,000 cows) and 11.2 km upwind from the dairy area were taken. The samples indicated distillable N concentrations of 190 and 6u g/m (3) respectively. Readings were also taken during a 24-hour period of the distillable-N concentration of a downwind corral fence of an isolated 600-cow dairy. This information indicated significant N loss from dairy waste by $NH_3$ volatilization. Meteorological factors greatly affected atmospheric concentrations of distillable N, particularly temperature inversions in the atmosphere and wind, along with proximity to the waste. Winds averaging 9.3 km/hour transported distillable N 500 m from the isolated dairy at a height of about 1.2 m. (Kehl-East Central)

## 2257-A4, B1, E1, F1, F2

### CURRENT LIVESTOCK POLLUTION REGULATIONS

L. Lubinus and F. Kerr
Cooperative Extension Service, South Dakota State University, Brookings, August, 1974, 5 p.

Descriptors: *Water pollution, *Permits, *Livestock
Identifiers: *Point source, Technical assistance, Feedlot effluent standards

Public-Law 92-500 amended the Federal Water Pollution Control Act and was enacted October 18, 1972. It prohibits the discharge of pollutants (including livestock wastes) into any stream, lake or river from a point source without a permit issued from one of two offices. These permits are issued by the Federal Environmental Protection Agency's (EPA) regional office in Denver, Colorado, or from the South Dakota Department of Environmental Protection (DEP). The term "point source" is defined in terms of large and small feeding facilities using the type and number of animals to define the size. The NPDES (National Pollution Discharge Elimination System) is in charge of the permit program at the national level. Instructions of how and where to apply for a permit are given. Feedlot effluent standards, cost-sharing programs and technical assistance are briefly discussed. (Kehl-East Central)

## 2258-B1, C3, D3

### THE BACTERIAL POPULATION OF PIGGERY-WASTE ANAEROBIC DIGESTERS

Rowett Research Institute, Bucksburn, Aberdeen
P. N. Hobson and B. G. Shaw
Water Research, Vol. 8, p. 507-516, 1974. 1 tab., 31 ref.

Descriptors: *Anaerobic digestion, *Bacteria, Sludge, Methane
Identifiers: *Piggery wastes, *Bacterial population, Facultative bacteria

Previous studies of piggery waste have described the setting up and running of laboratory-scale fermentors digesting piggery waste. This study not only covered the practical details of obtaining good digestion, but observations were made on the flora of the digesters during the setting up of digestion and while a balanced digestion was proceeding. The study made a survey of anaerobic and facultatively anaerobic bacteria present in piggery waste, digesting piggery waste and domestic anaerobic sludge used in starting a piggery waste digester. An influence of the input waste was shown in that streptococci were the predominant bacteria in the digesting waste, replacing Enterobacter when a piggery waste digestion had been established from the latter material. All the bacteria concerned in degradation of the waste constituents were anaerobes. Methane production from $H_2/CO_2$ formate and butyrate could be detected in mixed culture from digester contents dilution, but the only methanogenic bacterium that could be isolated in pure culture was Methanobacterium formicicum, which uses $H_2/CO_2$ or formate only. (Kehl-East Central)

## 2259-A7,A11,A12,B1,C3

### BACTERIAL CONTAMINATION OF HATCHING EGGS AND CHICKS PRODUCED BY BROILER BREEDERS HOUSED IN LITTER-SLAT AND SLOPING FLOOR MANAGEMENT SYSTEMS

Poultry Science and Veterinary Science Departments, The Pennsylvania State University, University Park 16802
T. A. Carter, R. F. Gentry and G. O. Bressler

Descriptors: *Bacteria, *Poultry
Identifiers: *Hatching eggs, *Chicks, *Bacterial contamination, *Litter-slat system, *Sloping floor system

Previous studies have indicated that air and egg shell bacterial counts are lowered when Leghorns or broiler breeders are kept in wire-floored houses instead of litter-floored houses. The two main objectives of this study are concerned with the study of bacterial contamination. The primary objective was to determine if any differences existed in the type and amount of bacterial contamination in eggs and chicks produced by sloping floor and litter-slat waste management systems. The second objective was the development of procedures which would prevent extraneous contamination of the eggs from the time of collection through hatching. Gnotobiotic incubation, hatching and rearing methods were utilized. The bacterial count of shells of eggs from breeders in the sloping floor system were significantly less than that for egg shells of breeders in the litter-slat system. Day-old chick bacterial contamination was low with no marked difference between systems. More types of enteric bacteria were isolated from chicks of breeders in litter-slat systems when eggs were untreated or dipped in a quarternary ammonium and chicks chill stressed. There were no differences however, in the number of types of enteric bacteria isolated from chicks of breeders in either sloping floor or litter-slat systems when eggs were sterilized using mercuric chloride and chicks chill stressed. (Kehl-East Central)

## 2260-A2, A5, A6, A8, A11, A12, B1, E2, E3, F2

### BEEF CATTLE FEEDLOT WASTE MANAGEMENT RESEARCH IN THE GREAT PLAINS

North Central Region, Agricutural Research Service, U. S. Department of Agriculture, Lincoln, Nebraska
T. M. McCalla
Control of Agriculture-related Pollution in the Great Plains, Seminar, Lincoln, Nebraska, July 24-25, 1972, p. 49-61. 4 tab., 184 ref.

Descriptors: *Research and development, *Cattle, *Great Plains, *Feedlots, *Design, Agricultural runoff, Soil contamination, Groundwater, Odor, Costs, Regulation, Diseases

The Agricultural Research Service, USDA and the Agricultural Experiment Stations are carrying on animal waste management research on beef cattle feedlots in the Great Plains. A summary of this research was presented before a meeting sponsored by the Great Plains Agricultural Council in Fort Collins, Colorado, March 13-15, 1972. Results of this reseach are discussed, calling attention to some of the areas that need additional emphasis. The topics that were briefly examined were (1) runoff from beef cattle feedlots, (2) soil pollution, (3) groundwater, (4) odors, (5) land-loading, (6) disease problems, (7) cost of establishing animal waste management practices, (8) regulatory aspects, (9) confinement house feeding and (10) manure as feed. It was concluded that some waste management systems for dirt beef cattle feedlots have been developed that are both workable and economical to construct. The study also concluded that much remains to be done to develop better designs for animal waste management, both on dirt lots and in confinement housing units. Studies are underway on the use of manure as feed and to determine the maximum rate of land application of effluent and manure from feedlots. Odor continues to be a feedlot problem. (Kehl-East Central)

## 2261-B2, C1, C2, E2, F3

### DISPOSAL OF FARM ANIMAL WASTES THROUGH THE SOIL

Oregon State University
M. G. Cropsey and V. Van Volk
Agricultural Engineering Annual Report of Research 1971-72, Agricultural Experiment Station, Oregon State University, Corvallis, 1972, 24 p. 1 fig., 14 tab.

Descriptors: *Waste disposal, *Cattle industry, *Irrigation, Slurries, Chemical properties
Identifiers: *Land disposal, *Waste water quality

Disposal of livestock manure through an irrigation pumping system has proven economically successful, but some questions still need to be answered. The objective of this study was to determine the effect of large and frequent applications of dairy cow wastes on the soil. Another study objective was to determine the quality of waste water in the soil and in the drainage water from such soil sites. The Oregon State University Dairy Farm was used for the study. It was determined that dairy manure slurry should not be applied the first year or two to a soil plot that has recently been installed with drain tile. This is advised because the slurry will short circuit through the freshly dug soil to the drain tile. When compared with the effluent applied there was a considerable reduction in TS, BOD and all forms of phosphorus and nitrogen in the dry wells and the drain tile. A considerable portion of both the liquids and solids was observed to be retained either in the soil or on the surface. It was observed that the wind has considerable influence over the distribution of the manure water slurry. Recommendations for further investigation and some advice on application is given. (Kehl-East Central)

## 2262-B2,B3,B5,C1,C2,C3,D1

### PROPERTIES RELATED TO MATERIALS HANDLING

Agricultural Engineering Department, North Dakota State University, Fargo
G. L. Pratt
Presented at Animal Waste Conference on Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, Chicago, Illinois, December 11-12, 1972. 2 fig., 2 tab., 21 ref.

Descriptors: *Physical properties, Waste storage, Transportation, Waste disposal, Pumping, Separation techniques, Filtration, Centrifugation, Design
Identifiers: *Waste management, Dilution, Loading, Gutter flushing, Settling tanks

Manure and modified manure have a variety of forms such as solid and diluted. These forms must be considered in developing an analysis of handling systems for these materials. Loading, storage, transport and disposal are the basic handling processes that are involved. Under the heading of manure transport, the aspects discussed are pumping, pipeline transport of manure and gutter flushing. Liquid solid separation is discussed in terms of settling tanks and channels, filters and centrifuges. There are several factors that affect the quality of manure. They are: (1) differences in the basic wastes from different animals, (2) the animal's age, (3) the ration fed to the animals, (4) animal environment, (5) manure moisture and (6) the treatment processes that manure may be exposed to. Tables on the differences in quality and in production rates of manure for different kinds of animals are given. Also additional figures are given to further define characteristics of manure that will influence the design of handling systems. (Kehl-East Central)

## 2263-A4, A6, A11, B1, C3, D2, D3, E4, F1

### KINETICS AND ECONOMICS OF ANAEROBIC DIGESTION OF ANIMAL WASTE

Department of Chemical Engineering, Missouri University, Rolla 65401
J. L. Gaddy, K. L. Park, and E. D. Rapp
Water, Air, and Soil Pollution, Vol. 3, No. 2, p. 161-169, June, 1974. 2 fig., 2 tab., 15 ref.

Descriptors: *Kinetics, *Economics, *Animal wastes, Feedlots, Waste disposal, Waste treatment, Carbon dioxide, Methane
Identifiers: *Anaerobic fermentation

During the process of raising cattle in this nation, approximately 1,008 × 10(12) kg (Ensminger, 1972) of solid waste (manure) are generated. The natural decays process disseminates the manure so that no harmful effects result when the animals are concentrated in large feedlots for fattening. The quantities of manure accumulate and create serious health hazards and pollution. This animal waste contains harmful bacteria, imposes a high biological oxygen demand on our waterways, and has an objectionable odor. A scheme, based on the process of converting animal waste to $CO_2$ and $CH_4$ by the autocatalytic process of anaerobic fermentation, for waste disposal from large feedlots is presented. This process design is based on kinetic data from the literature which are fitted to a kinetic model including diffusional resistance. An economic incentive for this process is provided by the sale of the $CH_4$. A return on investment of 23% yr.(1) from the sale of $CH_4$ appears to be possible for a large feedlot. (Kehl-East Central)

## 2264-A9, A10, B5

### LARVICIDAL ACTIVITY TO FLIES OF MANURE FROM CHICKS ADMINISTERED INSECTICIDE-TREATED FEED

College of Tropical Agriculture, Hawaii University, Honolulu
M. Sherman, G. H. Komatsu, and J. Ikeda
Jonrnal of Economic Entomology, Vol. 60, No. 5, p. 1395-1403, October, 1967. 2 tab., 10 ref.

Descriptors: *Insecticides, *Feeds, *Poultry, *Larvae
Identifiers: *House flies

A study was done to determine the effectiveness of 44 insecticides administered in the feed of chicks in controlling the larvae of 4 species of house flies. The insecticides included 1 chlorinated hydrocarbon, 6 phosphates, 1 carbonate, 6 phosphorothionates, 9 carbamates, 2 phosphorothiolates, 2 phosphonotrithioates, 10 phosphorodithioates, 3 phosphonodithioates, 1 phosphorotrithioate, and 3 phosphonothioates. The fly species included *Musca domestica* L.; *Fannia pusio* (Wiedemann) *Chrysomya megacephala* (F); and *Parasaracophaga argyrostoma* (Robineau-Desvoidy). *P. argyrostoma* was the most tolerant species to insecticide-containing manure. Eleven of the insecticides were highly toxic to at least 3 of the species after passage through the chick. The larval mortality was also determined in droppings inoculated directly with the insecticides. Relatively low levels of 20 of the insecticides were effective in controlling at least 3 species by this method of administration. Tables listing the insecticides and their effects on the larvae are given. (Kehl-East Central)

## 2265-A8, B2, C2, F1

### SPRAY IRRIGATION OF DAIRY CATTLE MANURE EFFLUENT FOR MAXIMIZING CROP PRODUCTION

D. E. Baker, D. L. Stoddard, and R. M. Eshelman
Compost Science, Vol. 16, No. 1, p. 10-15, January-February, 1975. 12 tab.

Descriptors: *Spray irrigation, *Cattle, *Dairy industry, *Effluent, *Crop response, Nitrogen, Soybeans, Pennsylvania
Identifiers: Corn

A study was conducted at Green Valley Farms, Avondale, Pennsylvania, with the objective of developing a system which would use cow manure effluent in a pollution-abatement program which would insure high corn yields and reduce the cost of fertilizer. Experimental plots were established to supply three replications and three variable treatments in early May after plowing and disking. The variable treatments included the normal farm fertilization (check), manure effluent and manure effluent plus solution N (Uran-30). Corn and soybeans were planted and monitored. The soil testing and forage analyses yielded the following guidelines. The potential for corn at Green Valley using manure effluent should be 200 bushels of grain or 30 tons of silage per acre. The nitrogen requirements would be about 300 pounds of N per acre. Of the 300 pounds, 60 would be released by the soil, 15 would be from starter fertilizer and the remaining 225 would be supplied with manure effluent and fertilizer N added to it. Adjustments would be necessary for supplying the N requirements of other crops. Grass silage crops should receive approximately 50 pounds of fertilizer N for each cutting. Nitrogen fertilization of soybeans requires further study. All Legumes should be inoculated to allow maximum fixation of nitrogen from the atmosphere. Addition of nitrogen at the time of maximum utilization by the crop might enable greater fixation from the atmosphere as well as greater efficiency from applied nitrogen. (Merryman-East Central)

## 2266-A11, B3, C2, E3

### VALUE OF DRIED CATTLE MANURE AS A FEEDSTUFF FOR POULTRY

Division of Poultry Science, Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel
B. Lipstein
Feedstuffs, Vol. 45, No. 24, June 11, 1973. 4 fig., 19 ref.

Descriptors: *Feeds, *Poultry, *Energy, *Performance, *Nitrogen
Identifiers: *Dried cattle manure, Broilers, Laying hens

The objectives of this study were to determine (a) the effect of rations containing dried cattle manure (DCM) on the well-being and performance of growing and laying chickens, and (b) the utilization of the energy and nitrogen found in DCM by these birds. DCM was substituted in different amounts (up to 30%) for sorghum grain and pulverized basalt rock in the diets of broilers and laying hens. The DCM seemed to be devoid of any caloric value for growing birds; whereas for layers, its ME content was approximately 500 kcal./kg. The apparent retention of the nitrogen found in DCM (equivalent of 12% crude protein) appeared to be very low. Hence, DCM is unsuitable as a dietary ingredient unless the purpose is lower nutrient density. (Merryman-East Central)

## 2267-A11, B3, C2, E3

### OBSERVATIONS ON THE NUTRITIVE VALUE OF CHICKEN MANURE FOR CATTLE

Department of Animal Husbandry, Cornell University, Ithaca, New York
L. S. Bull and J. T. Reid
Unpublished Report, Cornell University, Agricultural Experiment Station, 1965, 12 p. 7 tab., 13 ref.

Descriptors: *Feeds, *Nutrition, Poultry, Cattle, Performance, Nitrogen
Identifiers: *Dried poultry manure, *Refeeding

Observations are made concerning the use of air-dried chicken manure (ADM) as a nitrogen source for cattle. Specific experimental objectives were: (1) To study the acceptability of chicken manure as a part of the diet of dry and milking cows and (2) To determine the degree to which young, growing ruminants utilize the nitrogen, energy and nutrients of chicken manure. It was determined that: (1) Both cows and growing cattle consumed sufficient quantites of dried, "pure" chicken manure when added to low nitrogen diets to satisfy their nitrogen requirements. (2) The rate of chicken manure acceptance was determined by preparation method, the ration's physical properties, the type of feeds to which it is added, and individual preferences. (3) Satisfactory performance in terms of body weight gain and milk production, flavor and composition was obtained from diets with ADM as a major source of nitrogen. (4) Additions of ADM to a low-nitrogen basal diet resulted in an increase in digestibility of dry matter, energy, nitrogen, ether extract, and carbohydrate. With additional ADM increments, the digestibility of nitrogen increased progressively whereas nitrogen retention decreased progressively. (5) No digestive upsets or malfunctions could be attributed to feeding of ADM. (7) The ADM was not found to have large numbers of Salmonella or coliform organisms. (8) Chicken manure's main nutritive value is in the nitrogen, calcium and phosphorus it contains. (Merryman-East Central)

## 2268-A9, A10, B1

### FLY CONTROL ON POULTRY FARMS

Extension Entomologist, Cooperative Extension Service, College of Agriculture and National Resources, The University of Connecticut, Storrs
M. G. Savos
Publication No. 72-12, Cooperative Extension Service, University of Connecticut, Storrs, 1972, 2 p.

Descriptors: *Insecticides, *Fly control, Sanitation, Open floor system, Manure pit system, Cage system

Successful fly control programs involve sanitation and the use of insecticides. Manure management to minimize fly breeding was discussed briefly. A list of insecticides which can be applied to manure pits was given. (McQuitty & Barber-University of Alberta)

## 2269-A8, E2

### MANURE ON MILLET

United States Department of Agriculture
Agricultural Research, Vol. 20, No. 2, p. 16, 1971.

Descriptors: Ammonia, Toxicity, Nitrates
Identifiers: *Manure, *Millet, *Application rates,

Application of 65 tons/acre of dry cattle manure in the surface 8 inches of soil had no harmful effects on root development of millet in Alabama tests; however, when the same amount of manure was applied as a continuous layer (laid as a subsurface layer to simulate plowed-in manure), millet roots were considerably restricted, probably due to inadequate oxygen supplies rather than ammonia toxicity. The nitrate content of percolating water was increased by the plowed-in layer of manure, but not by the incorporated manure. Top growth of millet was increased by both manure treatments, but the increase in growth was greater for the incorporated than for the plowed-in manure. (McQuitty & Barber-University of Alberta)

## 2270-A2, A4, A5, A8, B1

### BRAKING FEEDLOT RUNOFF

United States Department of Agriculture
Agricultural Research, Vol. 19, No. 2, p. 5, February, 1971. 1 fig.

Descriptors: *Runoff control, *Feedlots, *Nebraska, Water pollution, Groundwater, Sampling,
Identifiers: Soil cores

This article reports on two management systems that limit pollution of streams and groundwater from beef cattle feedlots which are currently under development in Nebraska. Collection basins are utilized to trap the runoff. Runoff recording equipment and groundwater sampling wells have been installed at two test feedlots. At one feedlot, steel cased wells (caissons) have been installed to a depth of 12 ft. to allow a study of soil gases and pollutants moving downward under various conditions in the feedlot. Soil cores have been and are being taken for analysis. (McQuitty & Barber-University of Alberta)

## 2271-A6, A7, B1, D1
### POULTRY HOUSES THAT MAKE GOOD NEIGHBORS
United States Department of Agriculture
Agricultural Research, Vol. 20, No. 6, p. 12, 1971
2 fig.

Descriptors: *Odor, *Dusts, *Ventilation, Ammonia, Gases, Water
Identifiers: *Poultry houses, Spray chambers

ARS scientists are experimenting with spray chambers for elimination of odor and dust emmissions from poultry houses. In the spray chamber, which is located next to the exhaust fans, water combines with ammonia and other malodorous gases and carries them away in solution. Dust is also trapped by the water spray. (McQuitty & Barber-University of Alberta)

## 2272-A8, C2, E2
### MANAGEMENT PROCEDURES FOR EFFECTIVE FERTILIZATION WITH POULTRY MANURE
Department of Soils and Plant Nutrition, California University, Davis 95616
Compost Science, Vol. 16, No. 1, p. 5-9, January-February, 1975. 6 fig., 3 tab., 16 ref.

Descriptors: *Poultry, *Fertilizers, *Nitrogen, *Crop response, Ammonia, Nitrites, Toxicity, Nitrificaiton
Identifiers: *Excreta, *Land disposal, Uric acid

Animal manures utilized effectively as fertilizers for crop production promote efficient recycling of mineral and energy resources while providing an outlet for large quantities of animal waste. The experiments reported upon were designed to evaluate the use of ammonia, nitrate, and uric acid from poultry manures upon corn crops. Conclusions concerning the use of poultry manures as nitrogen fertilizers are: (1) the decomposition of uric acid in fresh poultry manure releases substantial amounts of $NH_3$, (2) if rates of application of manure are kept low, the toxicity problem can be avoided altogether, (3) with higher rates of application, an incubation period of about one month after application and before planting will allow for nitrification of the ammonia produced, (4) incorporation of carbonaceous waste materials, such as straw, with poultry manure fertilizers can reduce potential toxicity hazards. (Battles-East Central)

## 2273-A2, A11, B1, E3
### PROGRESS REPORTED IN HANDLING ANIMAL WASTES, RECYCLING IN FEED
Editor of Feedstuffs
D. Natz
Feedstuffs, Vol. 44, p. 2, 53, February 14, 1972.

Descriptors: *Recycling, *Feeds, Swine, Proteins, Costs, Agricultural runoff
Identifiers: *Refeeding, *Dried poultry waste, *Waste management, Continuous feeding, Food and Drug Administation

The author reviews the Cornell 1972 Conference with emphasis on the papers dealing with refeeding. Bergdoll's recommendation of feeding dried poultry waste from layers (which are fed few antibiotics or other drugs) to beef cattle is cited in particular. (Whetstone, Parker, & Wells-Texas Tech University)

## 2274-A11, A12, C2, E3
### FEEDING WASTES
Feedstuffs, Vol. 43, p. 14, December 11, 1971.

Descriptors: *Feeds, *Nutrients, *Performance
Identifiers: *Dried swine feces, *Dehydrated poultry wastes

Tests at Michigan State University in the feeding of dried swine feces (DSF) and dehydrated poultry waste (DPW) to swine are described. It was concluded that finishing pigs will consume corn-soy rations containing up to 22 percent of the DSF at 90 to 95 percent full appetite, that rate and efficiency of gain will be depressed by the incorporation of DSF in corn-soy rations to replace all or most of the soybean meal, that inclusion of DSF does not affect flavor or acceptability of the meat, and that DPW is of somewhat less value than DSF in swine rations. (Whetstone, Parker, and Wells-Texas Tech University)

## 2275-E3, F1
### CATTLE AS AN ECONOMIC BASE FOR AN ECOLOGICAL LOOP
Hoffman-La Roche Inc.
P. Meinhardt
Feedstuffs, Vol. 43, p. 18, 20, July 3, 1971. 5 tab., 20 ref.

Descriptors: *Cattle, *Economics, *Feedlots, *Organic wastes, *Feeds
Identifiers: *Refeeding

Among the conclusions stated are the following: "1. Utilizing only organic wastes and marginal land, it may now be feasible to produce an abundance of beef without using human foodstuffs — the nature of the ruminant stomach, the genetic flexibility of cattle, and the worldwide acceptance of beef make this possible. 2. Beef may be produced on a large scale, at less than 5c per pound, by locating drylot breeding facilities and feedlots in and around cities — at urban fringes and in city dumps — even the manure becomes a valuable resource for refeeding, fertilizing, or producing electricity — a major source of economies are (1) close proximity for all production inputs to minimize transport costs; (2) nearness to cheap feeds (garbage); and (3) the production of beef close to urban markets using devalued land. Sufficient organic waste exists in most countries to feed an abundance of beef — waste vegetation, industry wastes, paper, manure, and even sewage, when properly fed and supplemented, can feed beef." (Whetstone, Parker, & Wells-Texas Tech University)

## 2276-A10, B1, B5
### THE FALLACY OF DEEP PITS FOR POULTRY HOUSES
Poultry Management Consultant, DeKalb AgResearch, Inc., DeKalb, Illinois
J. W. Claybaugh

Descriptors: *Design, *Ventilation, Nutrients, Costs, Rodents
Identifiers: *Deep pits, *Poultry houses

The major disadvantage of a deep pit is the deterioration in nutrient quality of the manure. Others are the additional cost of the building, the possibility of water leakage leading to anaerobic conditions in the pit, and the attraction of a deep pit for home-seeking rodents To obtain good air flow patterns, separate ventilating systems may be required for birds and pit. (Whetstone, Parker, and Wells-Texas Tech University)

## 2277-A8, C2, E2
### LONG-TERM EFFECTS OF MANURE, FERTILIZER, AND PLOW DEPTH ON CHEMICAL PROPERTIES OF SOILS AND NUTRIENT MOVEMENT IN A MONOCULTURE CORN SYSTEM
Crop and Soil Sciences Department, Michigan State University, East Lansing 45823
M. L. Vitosh, J. F. Davis, and B. D. Knezek
Journal of Environmental Quality, Vol. 2, No. 2, p. 296-299, April/June, 1973. 5 tab., 20 ref.

Descriptors: *Fertilizers, *Chemical properties, *Soils, *Nutrients, *Organic matter, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Silage
Identifiers: *Manure, *Plow depth, *Nutrient movement, *Corn, *Application rates, pH

An evaluation of soil chemical properties, organic matter and nutrient accumulations, and nutrient movement and recovery after 6 and 9 years annual fertilizer and manure applications to continuous corn was conducted on two soil types — Conover-Hodunk loam and Metea sandy loam. The field experiments took place at the Michigan State University Soils Farm at East Lansing. Plow depths of 18 versus 30 cm had little or no effect on soil test values or nutrient accumulation patterns in the surface of a Conover-Hodunk loam soil. The pH value of both soils decreased slightly more than 0.1 pH unit per year with the annual application of 168 kg of N/ha as ammonium sulfate. Available P, soil organic matter, and exchangeable K, Ca, and Mg increased with increasing rates of manure. The differential removal of nutrients by grain and silage had no effect on soil available P. Soil test changes for Ca, K, and Mg were proportional to the net addition of each nutrient; but less than 30% of the net nutrients added could be accounted for in surface samples from the silage area where 67.2 tons of manure was applied annually. The most favorable rate of manure for the Metea-sandy loam soil was 22.4 metric tons ha (10 tons/acre). Larger applications caused a significant buildup of exchangeable K in the surface and subsurface horizons and resulted in inefficient use of soil nutrients. The K buildup was less critical on the loam soil or where silage rather than grain was removed. (Battlez-East Central)

## 2278-A11,B2,C2,C3,D3,E3,F5
### CONVERTING SWINE WASTE INTO A NUTRIENT SOURCE FOR SWINE
B. G. Harmon, D. L. Day, A. H. Jensen, and D. H. Baker
Proceedings, Illinois Pork Industry Day, Paper No. As-665d, University of Illinois, December 4-11, 1973, p. 15-19. 1 fig., 4 tab., 10 ref.

Descriptors: *Recycling, Feeds, Nutrients, Proteins, Fermentation, Parasites
Identifiers: *Swine, *Oxidation ditch mixed liquor, Illinois

In studies conducted at the University of Illinois, waste serves as a substrate in a fermentation system for the production of single-cell protein. The biological enhancement of the substrate is carried out in an oxidation ditch. Swine producers are currently using these ditches in waste management programs without realizing any nutrient return from the products. Nutritive value has been shown for products of the ditch in studies conducted with rats. No liquid effluent needs to leave the building since water must be added to the oxidation ditch in order to maintain the constant composition and level of the ditch. Precautions should be taken with the refeeding program described in this paper. Under abnormal conditions, nitrate levels of 5,000 parts per million have been measured. Such levels are toxic to swine. Management practices such as effective internal parasite control become exceedingly important, since ascarid eggs can be cycled back to the swine during the recycling process. (Cartmell-East Central)

## 2279-B1,C2,D2,E2,E3,F1
### NUTRIENT RECYCLING—MODERN ENERGY MANAGEMENT
President, Arizona Feeds, Tucson, Arizona
B. P. Cardon

Presented at IES 18th Meeting, New York, May 1-4, 1972, p. 262-266. 9 fig.

Descriptors: *Nutrients, *Recycling, *Energy, Incineration, Feeds, Economics
Identifiers: *Waste management, *Land disposal, *Building materials

Incineration, land disposal, and recycling as building materials are all options for waste disposal, but each has its inherent problems. Another option is a nutrient recycling approach in which energy of oxidation is used by selected microorganisms. The organisms are then harvested and used as a source of feed for animals. In this manner, the chemicals are recycled and the energy in the organic waste is captured in the microorganism cells and contributes to man's welfare as feed for livestock. Perhaps all or none of these methods may prove viable in the future, but one thing is clear. A manageable economic solution must be found to the pollution problem and the recycling of pollutants if the livestock industry is to continue to supply meat by-products to the public at a relative cost consistent with experiences of the past. (Merryman-East Central)

## 2280-A5, A8, C2

### THE NITROGEN STATUS BENEATH BEEF CATTLE FEEDLOTS IN EASTERN NEBRASKA

U. S. Department of Agriculture, Lincoln, Nebraska
J. R. Ellis, L. N. Mielke, and G. E. Schuman

Descriptors: *Feedlots, *Nitrogen, *Soil profile, *Nebraska, Cattle, Soil contamination, Groundwater pollution

The majority of the beef consumed in the United States comes from cattle fed in large, open, soil-surfaced feedlots in the Plains States and the Midwest. Feedlots are point sources of nitrogen since they provide intensive land use. The objective of this study was to examine the effects of beef-feedlot management systems on N accumulation in the soil profile and groundwater. Fifteen sites were selected in eastern Nebraska. Core samples were taken from feedlots, cropland-cattle-use areas and from cropland adjacent to feedlots to evaluate the effects of different management practices on the movement and accumulation of nitrogen in the soil profile. The soil texture of the feedlots sampled ranged from clay to coarse sand with the age of the feedlots ranging from a few weeks to more than 50 years. The sites examined were ranked according to decreasing average NO$_3$—N in the core as follows: abandoned feedlot, feedlot-cropland, upland feedlot, corn (Zea mays L.) river-valley feedlot, profiles under feedlot mounds, alfalfa (Medicago sativa L.) grassland. The study concluded that feedlot management is an important consideration in the accumulation of NO$_3$ in the soil profile. (Kehl-East Central)

## 2281-A6, B2, D3

### EVALUATION OF AERATED LAGOONS AS A MEANS OF SWINE WASTE STABILIZATION

G. E. Bennett
National Pork Industry Conference, Waste Management Workshop, November 9, 1967, 14 p. 5 fig., 13 ref.

Descriptors: *Aerobic lagoons, *Aeration, Design, Operation and maintenance, Odor
Identifiers: *Swine, *Waste stabilization

It would appear that there is a reasonable possibility that modified aerated lagoons could be satisfactorily used for treatment of swine wastes. Conclusive determination of this fact would require actual experimentation and research. Potential advantages are odor control, space and volume requirements, and elimination of the need for frequent disposal of sludge solids. (Wetherill-East Central)

## 2282-A6, B2, D2, D3

### THEORY AND PRACTICE OF ANAEROBIC DIGESTERS AND LAGOONS

Department of Agricultural Engineering, Ohio State University, Columbus, Ohio 43210
E. P. Taiganides
Proceedings, Second National Poultry Litter and Waste Management Seminar, College Station, Texas, September 30-October 1, 1968, p. 220-221. 3 fig., 1 tab., 14 ref.

Descriptors: *Anaerobic digestion, *Lagoons, *Poultry, *Design, Gases, Fermentation
Identifiers: *Malodors, Loading rates

Basic advantages of anaerobic processes are the stabilization of organic wastes at high rates in continuous fermentation, at a wide range of temperatures and environmental conditions, and the production of a high-energy, combustible gas, methane. These processes are suited to animal manure but the main limitation of the processes are malodors which emanate during the process. Design parameters for completely controlled and uncontrolled anaerobic processes in the treatment of poultry wastes are presented and discussed. Anaerobic digestion could prove to be one of the most effective methods of poultry waste disposal when research develops the engineering design criteria and means of controlling the odors associated intrinsically with the process. Design loading rates for anaerobic lagoons are 0.001 to 0.015 lb. volatile matter/day/cu. ft. of lagoon water volume. From the standpoint of odor acceptability, the recommended loading rate is 0.004 lb./day/cu. ft. This is equivalent to about 15 cu. ft. of lagoon water volume/hen. Digesters operating under controlled environment and at constant temperature above 70 F may be loaded at rates of 0.1 lb. Vm/day/cu. ft. On volumetric basis, 0.37 cu. ft. of digester volume/hen is suggested. At this rate, the gas produced is expected to be about 0.4 cu. ft./hen/day. This gas could have a heat value of about 200 BTU. (Solid Wastes Information Retrieval System)

## 2283-A2, B2, F1

### COSTS OF CONTROLLING FEEDLOT SURFACE RUNOFF

Agricultural Economics Department, Utah State University, Logan 84321
D. B. Nielsen and P. P. Olson
Utah Farmer-Stockman, Vol. 92, p. 10-11, October 5, 1972. 1 fig.

Descriptors: *Feedlots, *Agricultural runoff, *Costs, Utah, Runoff control
Identifiers: *Government assistance

Of the 31 feedlots in Utah capable of handling 100 head or more, 26 were assessed in a study of runoff potential. It appears that an expense of 18c per head fed would be involved in correcting runoff conditions. Of the lots, 12 had no runoff problem, 6 needed minor improvements, 5 needed major improvements, and 3 would find it more economical to relocate. (Whetstone, Parker, &Wells- Texas Tech University)

## 2284-A8, B2, C2, E2, F1

### PROFITS FROM DAIRY MANURE APPLICATION

Texas A&M University, College Station 77843
J. M. Sweeten, D. Forrest, A. C. Novosad, and A. Gerlow
"Results of 1974 Agricultural Demonstration — Harris County." Publication No. D-681, Texas Agricultural Extension Service, Texas A&M University, 1974, p. 51-52.

Descriptors: *Dairy industry, *Costs, *Profits, *Liquid wastes, Bermudagrass, Nutrients, Productivity
Identifiers: *Manure, *Land disposal

Profits from applying dairy manure to Coastal bermudagrass were determined in a 1974 extension result demonstration in Harris County. On an 80-cow, 187 acre dairy farm, the meadow was divided into a one-acre manure-treated plot and a one-acre control plot which received no manure. Both plots were treated with 300 pounds of 13-13-13 fertilizer and 200 pounds of ammonium nitrate in mid-summer. Applications of liquid manure at the rate of 11,000 gallons per acre provided a net profit of $164 per acre on a forage quality and yield basis. The 11,000 gallons of manure contained only 55 pounds of N, 18 pounds of P$_2$O$_5$, and 73 pounds of K$_2$O. The net production value of liquid dairy manure amounted to 1.5c per gallon. (Cameron-East Central)

## 2285-C2, D3, E1, F3

### POULTRY MANURE DISPOSAL AT CONVENTIONAL SEWAGE TREATMENT PLANTS

University of Connecticut, Storrs 06268
R. Laak, C. S. Shu, and J. J. Kolega
Presented at the 1974 Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974. 17 p. 3 fig., 7 tab., 28 ref.

Descriptors: *Poultry, *Waste disposal, Sludge, Effluent, Chemical properties
Identifiers: *Sewage treatment plants, pH, Volatile acids, Activated sludge treatment process

The amount of poultry manure that can be added safely to an activated sludge process has been studied. The objectives of this laboratory study were to (1) choose the proper discharge time for poultry manure, (2) find the suitable dilution (sewage-to-manure ratio), (3) evaluate the effect of manure addition on the effluent quality defined by parameters such as BOD$_5$, COD, nitrate, phosphate, D.O., suspended solids, etc., (4) observe the excess sludge and gas production and (5) find the effect of the manure sludge on the digester. The study showed a 100 to 1 ratio of sewage to poultry manure added during night flows did not significantly affect the activated sludge treatment process. An activated sludge plant with one million gallon per day flow should be able to treat in 4 hours the night flows of manure produced by 17,000 birds. A pilot study is recommended to confirm the promising laboratory results. (Cameron-East Central)

## 2286-A6, A7, C2

### IDENTIFICATION OF ODORS FROM CATTLE FEEDLOTS

Chemist, Air Pollution Research Center and Department of Soil Science and Agricultural Engineering, California University, Riverside.
E. R. Stephens
California Agriculture, Vol. 25, No. 1, p. 10-11, January, 1971. 1 fig., 1 tab.

Descriptors: *Odor, *Measurement, *Feedlots, *Cattle, California, Sampling, Chemical properties, Chromatography
Identifiers: *Identification, MR spectroscopy, Infrared spectroscopy, Mass spectrometry, Flame photometry

During 1967, 1968, and 1969, a small-scale project on the subject of feedlot odors was conducted in laboratories at the Statewide Air Pollution Research Center, the University of California, Riverside. The objective was to identify the odorant compounds from typical feedlot operations and to develop suitable chemical analytical methods for their detection and measurement. The project involved several phases, the first of which was sampling the air in or near the feedlot. The second phase involved analysis of odor-causing substances in the air by methods such as gas or liquid chromatrography, NMR spectroscopy, infrared spectroscopy, mass spectrometry, and flame photometry. The third phase was the analysis of subjective responses to humans to known concentrations of odoriferous air. From the study, it was discovered that the most important odorous compounds in feedlot air are the molecular amines, especially trimethylamine; but a contribution from other amines, ammonia, or other compounds cannot be ruled out. Furthermore, particular weather conditions or special feedlot operations may produce a different mix of odorants. (Solid Waste Information Retrieval System)

## 2287-A11, E3

### DIGESTIBILITY OF PROCESSED FEEDLOT MANURE

Colorado State University, Fort Collins, Colorado
G. M. Ward
Feedstuffs, Vol. 45, No. 28, July 9, 1973. 3 tab., 6 ref.

Descriptors: *Feeds, *Feedlots, *Cattle, *Sheep, *Proteins, *Performance
Identifiers: *Refeeding, *Cerola, Digestibility

Among the systems suggested to solve the current problem of feedlot manure utilization are several schemes for refeeding manure or fractions of the manure. The advantage that refeeding has over other systems is that the producers are the consumers and vice versa. The product cerola, discussed in this study, was produced from feedlot manure and fed to sheep to determine its digestibility. This source material was taken from a pen of Hereford steers receiving a ration of whole corn, hay and silage with a protein supplement. A description of the processing of the manure for feeding is given. Six crossbred lambs which averaged 61 lb. in weight were used in the digestion trial. The study showed that the nutrient digestibilities found were high considering the source of the product. An explanation for the higher percentage of crude fiber in Cerola as compared to corn is that poor digestibility of fiber is expected when a high concentrate diet is fed. The study also indicated that the protein intake (average 64 gm. of digestible protein) of these lambs would not support weight gains, but might be sufficient to maintain weight. Cerola is readily eaten by sheep and is highly digestible. Because of the encouraging results of this study, a processing plant to provide Cerola for feeding brood cows is being constructed at Sterling, Colorado. Results can be expected from these experiments this year. (Kehl-East Central)

## 2288-A6,A8,B2,D3,E2,F2

### AEROBIC TREATMENT OF FARM WASTES

New Zealand Agricultural Engineering Institute, Lincoln
D. J. Hills
New Zealand Journal of Agriculture, Vol. 128, No. 4, p. 42-44, April, 1973. 3 fig.

Descriptors: *Agricultural wastes, *Waste disposal, *Anaerobic treatment, *Aerobic treatment, Lagoons, Odors, Oxidation, Activated sludge, Municipal waters, Livestock, Aerated lagoons, Legislation, Oxidation lagoons
Identifiers: *New Zealand, Oxidation ditches, Piggeries

Since the Water and Soil Conservation Amendment Act of 1971, farmers have had to consider alternative treatment methods of their wastes, particularly livestock wastes. The most widely used waste disposal systems in New Zealand were anaerobic lagoons and spray disposal. However, in situations where these methods cause odors or agravate poor soil characteristics, aerobic treatment must be considered. Oxidation ditches and mechanically aerated lagoons are both modified forms of the municipal activated sludge treatment process. This may be applied to beef cattle and poultry wastes but is especially useful in piggeries. Mechanically aerated lagoons also may be used in New Zealand in the future. Surface aeration is of value as a means for odor control of wastes which will be subsequently spread on land. Various agricultural operations are noted, with their specific problems. These include piggeries, dairy sheds, beef cattle feedlots, poultry houses, and livestock. (Prague-FIRL)

## 2289-D2, E3

### MOLASSES FROM MANURE?

Poultry Digest, Vol. 31, No. 208, April, 1972.

Descriptors: *Feeds, *Sludge, Proteins
Identifiers: *Manure, *Molasses, Sulphur dioxide

"The Sulphur Institute reports that sulphur dioxide, an air pollutant from power and industrial plants, can be cooked with sludge, protecting the organic amino acids, in the sludge from degradation, and enhancing the protein values." If sludge, why not poultry manure which has lost most of its nitrogen? (Whetstone, Parker and Wells-Texas Tech University)

## 2290-A4, A6, A7, A11, A12, B2, B4, D1, D3

### NEW WASTE TREATMENT SYSTEM IS USED FOR HOGS

Agricultural Pollution Control Research Laboratory, Agricultural Engineering Department, Ohio State University
E. P. Taiganides
American Farmer, Vol. 47, No. 2, p. 6-7, 1972.

Descriptors: *Waste treatment, Separation techniques, *Liquid wastes, *Solid wastes, Odor, Biochemical oxygen demand, Aeration
Identifiers: *Swine, *Flushing

Although liquid systems have made it possible to mechanize manure handling to a greater extent than is possible with solid systems, new odor and water pollution problems have been created. Automated waste handling systems which do not create water or odor pollution will probably be in great demand in years to come. This study examined a treatment system in which flushing the manure out of the building played an important role. Flushing accomplished two things: (1) It prevented the release inside the building of noxious gases which affect the health and comfort of both animals and of the people working inside the building; (2) It ameliorated the problems of dust and odor and it automated manure removal. Flushing also enhanced the treatability of the manure in the aeration units outside the building by speeding up the liquification of the organic solids in the manure. At peak performance, an effluent of extremely high quality was produced. The BOD of the effluent was from 30-140 ppm and pH ranged from 6.5 to 8.4. There were no odors. The effluent was treated in an oxidation ditch, clarified, and recycled through the building as flushing water. The solids were screened out, aerated in an aerobic digestor, and stored before being pumped out for final disposal. There was trouble in getting the aerator to work properly but the problem was presumed to be in the wiring. Before a conclusion could be drawn on plant efficiency, its performance in freezing weather would have to be studied. (Kehl-East Central)

## 2291-B1, C3, D3, E3, F1

### FLY MANURE HIGH QUALITY PROTEIN SUPPLEMENT

Descriptors: *Feeds, *Proteins, Fertilizers
Identifiers: *Fly pupae, Manure, Flotation process

Poultry Digest, Vol. 29, p. 385, August, 1970.
Breeding colonies for pathogen-free houseflies were established. Eggs were collected and used to inoculate fresh poultry manure. The eggs hatch in five or six days and the larvae remove about 80 percent of the organic content and reduce the moisture content of the manure. The larvae and pupae are collected and processed into a high quality protein supplement. The economics appear favorable. (Whetstone, Parker, and Wells-Texas Tech)

## 2292-A4, B2, B4, C2

### MANURE HOLDING PONDS FOUND SELFSEALING

Area Soil and Water Technologist, Stanislaus County, California
J. L. Meyer, E. Olson, and D. Baier
California Agriculture, Vol. 26, No. 4, p. 14-15, May, 1972.

Descriptors: *Waste storage, *Water pollution, *Poultry industry, *Waste Water (Pollution), Salts, Sludge, Biochemical oxygen demand, Nitrogen, California
Identifiers: *Manure holding ponds, *Self sealing

Findings in a study of waste pond operations are reported. In the past, waste waters from poultry and dairy operations flowed to stream beds where they became part of the stream. Improved practices are imperative, since such waste waters are high in BOD, nitrates, dissolved solids, offensive constituents, and bacteria. One alternative available to handle animal wastes is the use of manure waste ponds. A test was run on 17 ponds in California which represented a wide range of soil textures, water table depths, and age. Results of various experiments are included in the article. Apparent anaerobic nitrogen losses of considerable magnitude occur under normal pond operation. Since much of manure dry solids are salt, ponds should be emptied frequently or whenever salt content reaches 2,900 ppm. A study of soil nitrate and salt showed that after several months of use, levels of nitrate and salt in soil solutions from below ponds showed very small changes. There is a very low rate of water loss from manure ponds. Sludge which developed on each soil bottom had very low nitrate-nitrogen contents and very high BOD values. Seepage of water from ponds amounted to only 1 mm per day. Soil solutions below the ponds had a lower concentration of all nutrients than adjacent well waters after 15 months. Thus artificial seals inside manure-laden reservoirs are not recommended. (Solid Waste Information Retrieval System)

## 2293-A8, B2, C2, C3, E2

### NITRIFICATION IN SOILS INCUBATED WITH PIG SLURRY

Agricultural and Food Bacteriology Department, Queen's University of Belfast, and Department of Agriculture, Newforge Lane, Belfast BT9 5PX, Northern Ireland
J. E. Cooper
Soil Biology and Biochemistry, Vol. 7, p. 119-124, 1975. 4 fig, 2 tab, 12 ref.

Descriptors: *Nitrification, *Soils, *Slurries
Identifiers: *Swine, *Land disposal, *pH, Nitrifying bacteria

Coinciding with the increased use of intensive methods of rearing livestock is the common practice of spreading animal slurries on agricultural land. Factors most likely to limit the use of slurry on cropland are the same as those applying to sewage sludge: concentration of heavy metals, survival of pathogenic bacteria and nitrogen content (Dotson, 7973). This study's objectives were: (1) to determine the effect of different quantities of slurry on nitrification and nitrifying bacteria; and (2) to compare nitrification patterns in slurry-treated soils with those in soils receiving $(NH_4)_2SO_4$ solutions of comparable nitrogen content. The results of the study are discussed in relation to heterotrophic nitrification in soils, and the practical implication of spreading slurry on agricultural land. Nitrification incubation studies (5 weeks at 30 degrees C) were made in a natural (PH 7.1) and an acid (PH 5.8) soil receiving varying concentrations of pig slurry and $(NH_4)_2SO_4$ solution. Observations at weekly intervals were made of mineral-N and pH changes and inorganic salts media were used to obtain separate estimates of the numbers of $NH_4$ +/— -N- and NO(2)-N- oxidizing bacteria. $NH_4$ +/— was nitrified to a greater extent than $(NH+_4)$ $(NH+_4)_2SO_4$ in an acid soil. In the neutral soil, an accumulation of NO(2)-N resulted from slurry additions. The pH of both soils, was raised more by the slurry than the $(NH_4)_2SO_4$ and nitrification was most rapid in a 2 week period of elevated pH following slurry applications in the acid soil. (Kehl-East Central)

### 2294-A11, B2, B4, D2, D3, E3

**FERMENTED POULTRY MANURE RECYCLED**

Poultry Digest, Vol. 30, p. 190, 1971

Descriptors: *Recycling, *Fermentation, *Poultry, Slurries, Bacteria
Identifiers: Heat treatment

Walter Langston, of Midwest Research Institute, "has worked with a 250,000-layer operation in which manure is collected in a tank where it is made into a slurry so it can be pumped. It is heat treated to kill disease organisms. Then, bacterial fermentation is used to upgrade the material so that it can be fed to the animal or bird, either as a wet material or dried. The entire process takes less than 36 hours." No ill effects appeared with recycling through the same chickens several times. (Whetsone, Parker, and Wells-Texas Tech University)

### 2295-D2, E3, F1

**POULTRY MANURE DRIED WITH MICROWAVES**

Poultry Digest, Vol. 30, p. 391, 1971

Descriptors: *Poultry, *Drying, *Microwaves, *Costs, Feeds, Fertilizers
Identifiers: *Great Britain

A British firm is reported to have developed a microwave drier with a one-ton per hour output. Costs of $2.40 per ton for continuous operation or $5 per ton on a forty-hour week are quoted for the machine which is priced between $50,000 and $60,000. "Dried manure emerges in a wide continuous strip. Since there is no odor, it would make a suitable garden fertilizer, but it is believed that the main outlet will be for ruminant feeds." (Whetstone, Parker, and Wells-Texas Tech University)

### 2296-A4, A8, B2, E2

**FOREST LAND AND MANURE DISPOSAL**

Poultry Digest, Vol. 30, p. 553, November, 1971

Descriptors: *Waste disposal, *Forest management, Nitrogen, Liquid wastes, Groundwater pollution
Identifiers: Tanker spreader

"Liquid manure was applied with a tractor-drawn tank spreader across a 30-ft. swath in a white pine plantation." It dried quickly and was dispersed by rains within two months. Flies were not attracted and the trees used the nitrogen effectively. Application rates must be governed to avoid nitrogen build-up in groundwater. (Whetstone, Parker, and Wells-Texas Tech University)

### 2297-A6, B2, B4, D1, D3

**MANURE HOLDING POND ODOR CONTROL**

R. A. Parsons
Poultry Digest, Vol. 31, p. 386, 1972.

Descriptors: *Aeration, Size
Identifiers: *Manure holding pond, *Odor control, *Floating aerators, *Sprinklers

Sprinklers or floating aerators are recommended for odor control on overloaded ponds. "For 10,000 hens, an aerator that puts 69 to 90 pounds of oxygen daily into the pond is suggested." (Whetsone, Parker, and Wells-Texas Tech University)

### 2298-C2, D2, E3, F1

**DRIED POULTRY WASTE AS FEED**

F. Price
Poultry Digest, Vol. 31, p. 348-349, 1972.

Descriptors: *Feeds, *Drying, *Costs, *Proteins, *Economics
Identifiers: *Dried poultry waste, *Refeeding, Europe

In European practice poultry manure is dried at lower temperatures and the exhaust gases are often run through an afterburner. Both practices reduce odors. Drying costs of $6 to $37 per ton have been reported. Protein contents range from three to 30 percent with low protein content accompanying high-temperature drying and drying of old manure. The value of DPW in poultry ration is about $18 per ton. It may be more valuable for ruminants than for poultry since ruminants can convert urea as uric acid to body proteins. Poultry can not. (Whetstone, Parker, and Wells-Texas Tech University)

### 2299-A11, B3, B4, C2, D2, E3, F1

**DPW RECYCLING FACTS UPDATED**

H. C. Zindel
Poultry Digest, Vol. 31, p. 125-126, 1972.

Descriptors: *Recycling, *Costs, *Performances, Layer hens, Dehydration, Nutrients
Identifiers: *Dried poultry wastes, * Refeeding

Studies at Michigan State University, including recycling 35 times with rations containing 12.5 percent and 25 percent DPW, have indicated that the practice is safe. No build-up of heavy metals has occurred. Operation costs will vary between $12 and $16 per dried ton without afterburners. With them, costs will about double. Properly processed and properly stored DPW "has a place in the list of ingredients for all animal rations." (Whetstone, Parker, and Wells-Texas Tech University)

### 2300-A11, B3, B4, C2, E3

**MANURE STORAGE TIME AFFECTS VALUE OF DPW**

Poultry Digest, Vol. 31, p. 205, 1972.

Descriptors: *Waste storage, *Proteins
Identifiers: *Dried poultry waste, *Refeeding, *Feed value

The protein percentage (dry basis) of dried poultry waste decreases from 30.3 for seven-day storage to 18.3 for 98-day storage of the manure before drying. Intermediate values are tabulated. After 31 recyclings of DPW with collection and drying at intervals averaging 12 days, the crude protein at the end of the first cycle was 29.7 percent. For a ration percentage of 12.5 percent, the crude protein after the 31st cycle was 27.9 percent. Phosphorus content was 2.4 percent after the first, 2.8 percent after the 31st. Egg production was 62.4 percent on the 12.5 percent refeed, 59.6 percent on the control diet (zero refeed), and 59.2 percent on 25 percent refeed. (Whetstone, Parker, and Wells-Texas Tech University)

### 2301-B3, E2

**OTHER FERTILIZER USES FOR DRIED MANURE**

Poultry Digest, Vol. 31, p. 136, 1972.

Descriptors: *Fertilizers, *Reclamation
Identifiers: *Dried poultry waste

Dried poultry manure in excess of market demand has proved useful in Pennsylvania on highway embankments, highly-acid strip mine lands, and other wastelands. (Whetstone, Parker, and Wells-Texas Tech University)

### 2302-B5, C1, C2, E2

**WHY POULTRY MANURE VARIES AS FERTILIZER**

Poultry Digest, Vol. 31, p. 90-91, 1972.

Descriptors: *Poultry, *Fertilizers, *Nitrogen, Phosphorus, Potassium, Moisture content
Identifiers: *Manure variation

Many farmers distrust poultry manure as a fertilizer because of uncertainty as to its content of nitrogen, phosphorus, and potassium. With "as is" samples in Riverside County, California, values ranged as follows: nitrogen: 0.5 percent — 6.0 percent by weight. Phosphorus: 0.5 percent — 3.0 percent, potassium: 0.4 percent — 2.0 percent, and water: 7.8 percent—69.5 percent. Major causes of the variation are moisture content, feed of poultry, and age of manure at time of drying or of delivery. (Whetstone, Parker, and Wells-Texas Tech University)

### 2303-A10, B1

**CHICKENS CONTROL FLIES FROM MANURE STACK**

Poultry Digest, Vol. 31, p. 546, 1972.

Descriptors: *Poultry, *Dairy industry
Identifiers: *Fly control, *Manure, Maggots

"Chickens which eat fly maggots in dairy manure stacks at the University of Wisconsin's Electric Research Farm are doing a good job of fly control . . ." Two hundred fifty cockerels are housed in a yard to which the daily manure production is brought. (Whetstone, Parker, and Wells-Texas Tech University)

### 2304-A11, A12, B3, C2, C3, E3, F1

**DATA NEEDED ON SAFETY OF RECYCLING WASTE**

Poultry Digest, Vol. 31, p. 294, 1972.

Descriptors: *Recycling, Pathogenic bacteria, Safety
Identifiers: *Refeeding, *Food and Drug Administration, Residues

The Food and Drug Administration is watching research results on the content of pathogens and residues harmful to animals and food in recycled litter. Until convinced of its safety, approval will continue to be withheld. Approval, if it comes, will be on a process-by-process basis as the safety of each process is established. (Whetstone, Parker, and Wells-Texas Tech University)

### 2305-A11, A12, B1, E3

**PROCESSED POULTRY MANURE AS A FEEDSTUFF**

Poultry Digest, Vol. 31, p. 537, 1972.

Descriptors: *Poultry, *Performance, Phosphorus, Amino Acids, Feeds
Identifiers: *Refeeding, *Feces

Poultry feces uncontaminated with litter may be fed to laying hens without detrimental effects on the health of the hens or on the taste of the eggs. DPW has a low energy content and is useful primarily for its phosphorus and amino acid content. It should not be fed to broilers and turkeys. Hens on DPW eat more (to get more energy) and produce more manure. (Whetstone, Parker, and Wells-Texas Tech University)

### 2306-A6, A10, B3, D1

**HOW NUTTING PRE-DRIES MANURE IN DEEP-PIT HOUSE**

Poultry Digest, Vol. 31, p. 385-386, 1972.

Descriptors: *Poultry, Drying, Moisture content, Odor
Identifiers: *Nutting, *Waste accumulation, *Deep pit house, Flies

Cones of manure build up on 1x4's some five inches apart suspended between cage and pit. The manure is air dried by an exhaust fan and pushed off into the pit semiannually. A four-year accumulation in the pit has a moisture content of 20 to 30 percent and a depth of 40 inches. It has little odor and attracts few flies. (Whetstone, Parker, and Wells-Texes Tech University)

### 2307-A2, A3, A4, B4, C2, C3

### FECAL COLIFORM POLLUTION IN AN AGRICULTURAL ENVIRONMENT

J. K. Jones
M. S. Thesis, Department of Microbiology, Colorado State University, 1971, 122 p. 7 fig, 10 tab, 84 ref.

Descriptors: *Water pollution, *Agricultural runoff, *Feedlots, Livestock, Coliforms, Ammonia, Nitrogen, Biochemical oxygen demand
Identifiers: Membrane filter

A study was undertaken with the primary objective of characterizing the types and numbers of coliform organisms occurring in fresh and stored livestock fecal wastes and in waters polluted by these wastes. A membrane filter procedure was used to detect the total coliform and fecal coliform groups and these groups were used to examine the significance of the organisms as indicators of livestock waste pollution. Fresh bovine, ovine and equine fecal samples showed an overall range of total coliform counts of 7400 to 65 million per gram dry weight and of fecal coliform counts, 5800 to 60 million per gram. In an environment of stored bovine manure, a reduction in numbers of coliforms occur. Complex interactions of the coliform population with the natural environment determine the types and numbers of indicator organisms that reach water supplies in runoff from a livestock rearing area. The ammonia nitrogen concentration and biochemical oxygen demand may be at very low levels even when coliform counts indicate that water pollution by runoff is occurring. The detection of fecal coliforms by the membrane filter FC test in waters polluted mainly by fecal wastes can be good; 95.2 percent of 733 FC positive colonies from water samples were confirmed as Escherichia IMViC types I or II. (Cartmell-East Central)

### 2308-A1, B4, C2

### NITROSATION IN FEEDLOT MANURE

P. D. Bergstrom
M. S. Thesis, Department of Microbiology, Colorado State University, 1971, 70 p. 8 fig, 5 tab, 45 ref.

Descriptors: *Waste storage, *Feedlots, *Nitrates, *Amines, Temperature, pH, Nitrates, Chromatography
Identifiers: *Nitrosation

This study was initiated to determine whether conditions permitting nitrosation exist during the normal storage of manure. The findings indicate that nitrites and amines occur in appreciable amounts in feedlot waste. The formation of nitrosamine was detected when the secondary amine concentration was artificially increased. The nitrite content in stored manure was high enough for nitrosamine synthesis, but in the samples examined the secondary amine content appeared to be the limiting factor. Nitrosamines were not detected in stored manure samples that were subjected to high temperature and low pH conditions. Therefore, the rate of nitrosamine synthesis in stored manure is not likely to be rapid enough to permit the accumulation of hazardous amounts of nitrosamine, during the normal storage of feedlot manure. (Cartmell-East Central)

### 2309-A6, B1, C2

### IDENTIFICATION AND CONTROL OF CATTLE FEEDLOT ODORS

R. S. Narayan
M. S. Thesis, Texas Tech University, Lubbock, Texas, 42 p. 9 fig, 4 tab, 29 ref.

Descriptors: *Odor, *Feedlots, *Cattle, Gases, Chromatography

The primary purpose of the project was to determine the qualitative nature of the gases present in the atmosphere around a beef cattle feedlot in hopes of devising an economically feasible odor control program. Qualitative nature, in terms of functional classification, of the gases present was sought, initially. Specific identification within each factional class was then attempted by gas chromatography. Environmental chamber studies were carried out to study the variation of chamber atmosphere employing different methods of chamber management. During the first phase of chamber management, only a few odiferous contaminants were generated. Among the compounds present, the most obnoxious were acetaldehyde and iso-butraldehyde. When daily washing down of the chamber was discontinued, indole and skatole, which are extremely odiferous, were detected in the chamber atmosphere. The biological degradation of organic matter results in the formation of organic functional groups such as alcohols, carbonyls, amines, esters, etc. Since implementation of a control scheme was not part of the project, no attempts were made to experimentally evaluate the suggested routes for odor control. (Cartmell-East Central)

### 2310-B2, D3, F3, F6

### A MODEL STUDY OF FLOW VELOCITIES IN AN OXIDATION DITCH

U. Agena
M. S. Thesis, Department of Agricultural Engineering, Iowa State University, Ames, 1968, 100 p. 36 fig, 9 tab, 30 ref.

Descriptors: Model studies, Design
Identifiers: *Oxidation ditch, Flow velocities

A model study of the velocities found in an oxidation ditch was conducted. The effects of changes in rotor speed, paddle finger width, paddle immersion depth, liquid depth, and channel length on the main liquid velocity were investigated. It was found that, providing all other pertinent quantities were held constant, the mean liquid velocity increased as rotor speed increased, as paddle finger width increased, as immersion depth increased, and as liquid decreased. Suggestions for further study were listed. (Cartmell-East Central)

### 2311-B1, C1, C2, D3, E2, F1

### CHARACTERISTICS AND TREATMENT OF WASTES FROM A CONFINEMENT HOG PRODUCTION UNIT

E. P. Taiganides
Ph. D. Dissertation, Iowa State University, Ames, 1963, 177 p. 31 fig, 14 tab, 44 ref.

Descriptors: *Waste treatment, *Confinement pens, *Chemical properties, *Physical properties, *Anaerobic digestion, Costs
Identifiers: *Swine, *Loading rates, Gas production

The objectives of this study were: (1) to determine qualitatively and quantitatively the physical and chemical characteristics of wastes from a hog confinement production unit, and (2) to evaluate the feasibility of using anaerobic digestion methods for the treatment of said waste prior to ultimate disposal on land. The quantity and composition of manure can be estimated from data on the following factors: the daily quantity and composition of the feed intake the water intake, the size of the hog and the air temperature within the confinement unit. Hog manure is digestible. At 950° F, with once a day feeding and with continuous mixing of the contents of a single stage digester, hog manure could be digested at a loading rate of .2 lb. of volatile solids per day per cubic foot of digester capacity and a detention period of less than 8 days. (Cartmell-East Central)

### 2312-A8, B2, E2

### FIELD TREATMENT AND DISPOSAL OF LIVESTOCK LAGOON EFFLUENT BY SOIL PERCOLATION

D. H. Vanderholm
M. S. Thesis, Department of Agricultural Engineering, Iowa State University, 1969, 62 p. 12 fig.,19, tab, 43 ref.

Descriptors: *Effluent, *Sprinkler irrigation, Lagoons, Soil profile, Nutrients
Identifiers: Land disposal, Application rates

In a field experiment it was concluded that livestock lagoon effluent can be applied to agricultural land by sprinkler irrigation without creating nuisance problems. Effluent application had no harmful effects under a periodic cover crop. When operated under a periodic loading and recovery schedule, practically no problem of clogging the soil surface or profile is likely. Infiltration rates for lagoon effluent are 20 to 50% lower than for clear water under the same conditions, and application rates should be reduced accordingly. Renovation characteristics of a soil treatment and disposal system are excellent. Some beneficial effect in crop production may be realized due to supplemental irrigation and possible increase in available nutrients. (Cartmell-East Central)

### 2313-A1, B1, D1, D2, D3, E2, E3, F4

### FEEDLOT MANURE AND OTHER AGRICULTURAL WASTES AS FUTURE MATERIAL AND ENERGY RESOURCES. 1. INTRODUCTION AND LITERATURE REVIEW

Department of Chemical Engineering, Kansas State University, Manhattan, Kansas 66502
W. P. Walawender, L. N. Fan, and L. E. Erickson
Report No. 26 of the Institute for Systems Design and Optimization, Kansas State University, Manhattan, April, 1972, 13 p. 35 ref.

Descriptors: *Feedlots, *Energy, Drying, Incineration, Aerobic treatment, Anaerobic conditions, Fuels
Identifiers: *Waste management, Agricultural wastes, *Manure, *Liquefaction, *Gasification, *Hydrogasification, Refeeding, Composting

Recently there has been considerable concern with preserving the environment in terms of air, water and land quality. The conservation of natural resources (both material and energy resources) has also been a topic of concern. The processing of feedlot manure was the object of this study, primarily because of its availability and because of present pollution problems. An introduction to the problem, a review of present feedlot waste management methods and a review of the available technology which may be applicable to the processing of manure is given. Factors complicating utilization of feedlot manure as a fertilizer have brought about alternative management schemes, such as aerobic and anaerobic treatment, incineration, drying, composting, and refeeding. Improved land disposal methods have also been developed. And last but not least, three alternative conversion processes have been developed—liquefaction of manure to produce oil; gasification of manure to produce a synthesis gas; and conversion of manure into methane using a hydrogasification process. There exists a present trend towards the development of the rural areas of our country. Such development will require energy sources which are presently heavily taxed. The resulting products of processing agricultural wastes may thus become a valuable asset to the development of rural areas. (Kehl-East Central)

### 2314-D2, D3, E3, F1

### FUEL FROM WASTES: A MINOR ENERGY SOURCE

T. H. Maugh II
Science, Vol. 178, No. 4061, p. 599-602, November 10, 1972. 1 tab.

Descriptors: *Fuels, *Organic wastes, *Energy, *Hydrogenation, Methane, Costs, Recycling, Oil
Identifiers: *Pyrolysis, *Bioconversion, Char

Conversion of organic wastes into fuels has developed as a method of possibly easing the energy crisis. The three major methods for such conversion are hydrogenation, pyrolysis, and bioconversion. The hydrogenation process, developed by H. R. Appell and I. Wender of Bumines' Pittsburgh Energy Research Center, converts as much as 99 percent of the carbon content of organic wastes to oil under optimum conditions. On a pilot scale, problems arose in relation to economic feasibility and technical problems in introducing waste to the reactor under pressure. Garrett Research and Development Company, La Verne, California, concluded that operational costs of pyrolysis or destructive distillation should be lower than for hydrogenation but the problem of collecting and marketing three fuels (gas, oil, and char) produced problems. Bioconversion produces methane at the rate of 10,000 scf for each ton of solid waste and is theoretically a simpler process than hydrogenation or pyrolysis. Problems of this process are: (1) the need for new techniques to feed solids into the digestors, and inexpensive methods for collection and purification of methane, (2) recirculation of the effluents, and (3) control of pollution. Each of the conversion methods are restricted by the limited amount of solid wastes available. A discussion of specific plants employing these recycling methods is included. (Battles-East Central)

## 2315-B2, C2

### THE STRATIFICATION OF AN ANAEROBIC DAIRY MANURE LAGOON

R. M. Mahan
M. S. Thesis, University of Florida, 1972, 42 p. 15 fig, 53 ref.

Descriptors: *Dairy industry, *Stratification, *Lagoons, *Anaerobic digestion, *Gases, Ammonia, Nitrogen

This study was undertaken to examine the stratification and interrelationships of several factors involved in the degradation processes of an anaerobic dairy manure lagoon. Parameters included: concentrations and species of the various volatile short-chain fatty acids, amount and composition of the evolved gases, and concentration changes of the ammonium bicarbonate buffering system. Short-chain fatty acids had parallel stratification patterns at each depth and the concentration of acetate exceeded those of the other fatty acids. Even though the rates of evolution varied, the composition of the evolved gas was usually consistent. The rate of gas evolution did not directly parallel fluctuation in the short-chain fatty acid pool sizes. Decline in both short-chain acid and the rate of gas evolution effected to degradation occurring within the lagoon. Ammonia-nitrogen was stratified and decreased in concentration during the course of the study. (Cartmell-East Central)

## 2316-B4, C1, C2, D1, F1, F3

### LIQUID-SOLID SEPARATION OF CATTLE MANURE BY VACUUM FILTRATION

L. F. Backer
M. S. Thesis, Agricultural Engineering Department, North Dakota State University, Fargo, May, 1972. 36 fig, 42 tab, 26 ref.

Descriptors: *Separation techniques, *Filtration, Physical properties, Chemical properties, Biological properties, Dewatering, Cattle.
Identifiers: *Liquid-solid separation, *Vacuum filtration.

The animal waste problem is growing due to our population increase and an increase in the consumption of beef and chickens. Several methods could be utilized for liquid-solid separation of wastes. This thesis is an attempt to investigate the use of vacuum filtration for the liquid-solid separation of manure without preconditioning. Physical, biological, and chemical characteristics of the liquids removed are recorded. The results of the study indicated that: (1) Total and volatile solids content in the filtrate was much greater than the total and volatile solids found in the liquids which drain from the barn at the present time, (2) Cake yield and filtrate yield are generally quite small due to the poor filtering characteristics of manure, (3) The proper vacuum filter size can be determined for a given size operation and for a given set of conditions, (4) Although a significant amount of dewatering was possible, more dewatering would be necessary for further processing. Dewatering capabilities appeared to increase with increasing temperature, (5) Cost of even a small (3 foot diameter x 1 foot width) vacuum filter is quite large (approximately $12,000). Suggestions for further investigations are also given. (Battles-East Central)

## 2317-A8, B2, B5, D1, D2, D3, E2

### FERTILIZATION VALUE OF CATTLE MANURE IN RELATION TO TREATMENT AND METHOD OF HANDLING

R. F. Hensler
M. S. Thesis, Soil Science Department, Wisconsin University, Madison, 73 p. 20 tab, 45 ref.

Descriptors: *Fertilizers, *Cattle, *Corn, *Liquid wastes
Identifiers: *Application rates, *Manure, Crop yields, pH

A study was made on the effect of type of manure, method of handling, amount of bedding, drying treatment and rate of application on the fertilizing value of cattle manure for corn. Two green house experiments were conducted. One was to determine the effect of fresh, fermented, aerobic liquid and anaerobic liquid dairy cow and steer manures, drying treatment and rate of application on the fertilizing value for corn grown on silt loam. The application of manure increased yields in all cases. The second was conducted to determine the effect of rate of addition of oat straw and wood shavings to fresh, fermented or anaerobic liquid dairy cow manures on their fertilizing value for corn grown on a silt loam. Again the yields of the crops increased by the application of manure in all cases. In a field experiment yields of both ear corn and stover were increased by the application of fresh fermented and anaerobic liquid manures, but the increases were only for the liquid manure placed in bands 4-6 inches from the row. The results of a laboratory experiment indicated that the addition of dilute $H_2SO_4$ to samples of manure to attain a pH of 5.0 or lower prevents loss of N on drying. (Cartmell-East Central)

## 2318-B2, B5, C2, D2, D3, E1

### THE EFFECTS OF LOADING RATES ON THE DESIGN AND OPERATION OF ANAEROBIC SWINE LAGOONS

Department of Agricultural Engineering
Clemson University, Clemson, South Carolina
H. P. Lynn
M. S. Thesis, Clemson University, Clemson, South Carolina, August, 1968, 73 p. 14 fig, 18 tab.

Descriptors: *Anaerobic lagoons, *Design, Biodegradation, Chemical degradation, Biochemical oxygen demand
Identifiers: *Loading rates, Sludge accumulation .

The growing of animals to maturity in total confinement has been made possible by agricultural engineers, working closely with animal scientists, poultrymen and other engineers. The handling and disposal of animal wastes has been intensified by the confinement of animal production because of the possible environmental pollution hazards and the cost of disposing of large quantities of high-moisture-content animal waste. The objectives of this study were: 1) to determine the quality of effluent and the effectiveness of a lagoon as a method of swine waste disposal under South Carolina climatic conditions, (2) to determine the effect of loading rate on sludge accumulation, (3) to develop design criteria needed for the satisfactory chemical and biological degradation of swine waste. The loading rates of one market-size hog per 60, 120, 180, and 240-cubic feet of lagoon, replicated four times, were used for the study. Except for occasional overflow during prolonged rainfall, the lagoons had no effluent. The lagoons used anaerobic digestion. The study revealed that the lagoon was an effective method of swine waste disposal, effectively reducing the BOD of untreated swine waste. The loading rate of the lagoons significantly affected the quality of effluent. There was a direct proportion of sludge accumulation to the amount of animal waste added to the lagoons. There was a more pronounced temperature effect on the BOD values for the 60- and 120-cubic-feet lagoons than on the 180-and 240-cubic-feet lagoons because of overloading and higher density of micro-organism population. Suggestions for design criteria are given. Kehl-East Central)

## 2319-A8, A12, B2, C3, E2

### THE MICROBIAL ECOLOGY OF CULTIVATED SOIL RECEIVING COW MANURE WASTE

F. B. Dazzo
MS Thesis, Florida University, Gainesville, 1972, 97 p. 31 fig, 12 tab, 78 ref.

Descriptors: *Farm wastes, *Solids, *Sprinkler irrigation, Rhizosphere, Bacteria, Oats, Sorghum
Identifiers: Microbial ecology, Fecal coliform, Millet

A study was made of the characterization of microbial problems associated with a possible treatment process involving the disposal of dairy waste slurry on land. A sprinkler irrigation system was located at the Dairy Research Unit of the University of Florida. The response of oat, sorghum, and millet to their rhizosphere microorganisms was determined to obtain a base line in toxicity and pathogenesis studies. Data collected showed a decline in the rhizosphere effect on bacteria, actinomycetes, fungi, algae, and on proteolytic, ureolytic, mycolytic, and lipolytic microorganisms. Data indicated that removal of fecal coliforms was most efficient in a soil lysimeter lacking a root system. Irrigating soil with cow manure slurry creates a health hazard since fecal coliforms and Salmonella enteretidis survived longer when introduced into receiving soils than control soils. (Cameron-East Central)

## 2320-A2, A4, B2, B3, B4, C1, D1, E1, E2, E3, F5

### THINK OF MANURE AS A RESOURCE, NOT A WASTE

T. M. McCalla
Feedlot Management, Vol. 14, No. 5, 2 p., May, 1972. 1 fig, 3 tab.

Descriptors: *Water pollution, *Agricultural runoff, *Feedlots, Settling basins, Fertilizers, Mounding, Recycling, Odor
Identifiers: Broad-basin terraces, Land disposal

Pollution of streams and lakes by feedlot runoff is a problem, but technology is available to combat it. If runoff is caught in broad-basin terraces or is allowed to settle out in settling basins, 50 percent or more of the solids will settle out. Reasons for catching these settleable solids are: (1) They contain most of the easily biodegradable material, (2) They reduce retention capacity, (3) If they get into a retention structure, they create anaerobic conditions resulting in foul odors. These solids may be used on the land for crop production or they may be put back on the feedlot for mounding. Mounding serves two purposes: (1) Mounds create an area that drains readily, generally is dry, and offers protection to the cattle from adverse weather conditions; and (2) they act as a compost heap for decomposition on the lot. Besides being used as fertilizer, manure can also be recycled as oil, feed, building materials, and as food for yeast which may be fed to animals. (Merryman-East Central)

## 2321-A6, C2

### QUALITATIVE MEASUREMENT AND SENSORY EVALUATION OF DAIRY WASTE ODOR

C. Ifeadi
Ph.D Dissertation, The Ohio State University, Columbus, 1972, 185 p. 45 fig. 27 tab. 110 ref.

Descriptors: *Odor, *Volatility, *Measurement, Diffusion, Gas chromatography
Identifiers: *Dairy wastes, *Dimethyl sulfide, *Diethyl sulfide, Chemical ionization, GC calibration

Odor control is a primary requirement for livestock production in an urban society. A study was undertaken to develop an odor analysis instrumentation for both objective and subjective measurement. The specific objectives of this study were: (1) to develop instrumentation and methodology for quantitative and organaleptic measurement of odor, (2) to measure objectively concentrations of major odor compounds which are released during the decomposition of dairy waste, and (3) to determine organoleptically odor thresholds of dairy wastes. The odor analysis instrumentation was designed, assembled, and operated in the Agricultural Pollution Control Research Laboratory of The Ohio State University. Conclusions were: (1) An adsorbent material, Chromosorb 102, was satisfactorily used to collect volatiles from decomposing dairy waste. (2) The combined use of GC and a chemical ionization mass spectrometer identified and confirmed the presence of dimethyl sulfide and diethyl sulfide, (3) The quantitative measurement of the diethyl and dimethyl sulfide released from stored diluted dairy waste gave an average value of 0.3 ppm for diethyl sulfide and 65.4 ppm for dimethyl sulfide for days that tests were conducted, (4) The sensory evaluation showed that diluted dairy waste had lower odor threshold level than the undiluted waste, and (5) Even though the concentration of dimethyl sulfide was greater than diethyl sulfide, the number of odor units associated with diethyl sulfide was found to be greater than that associated with dimethyl sulfide. (Cameron-East Central)

## 2322-B5, C2, C3, D3, E3, F2

### NEW MANURE CONVERSION PLANT OPENED

Calf News, Vol. 13, No. 6, p. 14, June 1975. 3 fig.

Descriptors: *Recycling, *Fertilizers, *Feeds, *Aerobic digestion, Regulation, Texas, Economics
Identifiers: *Manure

Searle Agriculture's BioCon Division has opened the biggest manure processing plant in the world near United Beef Producers at Summerfield, Texas. This $1,300,000 plant will use an aerobic bacteria digestion process to transform 200,000 tons of manure per year into a soil conditioner or eventually into a feed supplement for cattle. This odorless process kills pathogens and weed seeds, increases nutrient availability, and decreases biological oxygen demand of the product. The firm expects to sell fertilizer and soil conditioner for $20 per ton FOB the plant. Officials of the plant expect regulations to be published very soon concerning use of the product in feed. They do not feel that the regulations will be too tough, but they will require frequent testing. (Merryman-East Central)

## 2323-D2, D3, E3, E4

### OKLAHOMA MANURE FOR MIDWEST METHANE

Environment Midwest, p. 13, December, 1974.

Descriptors: *Methane, *Fuels, *Oklahoma, *Recycling, Cattle, Fertilizers
Identifiers: *Midwest United States, *Biogasification

People's Gas Company recently announced that methane gas generated from cattle manure will provide energy to several Midwest states by mid-1976. Natural Gas Pipeline Company of America has agreed to purchase the methane from Calorific Recovery Anaerobic Process, Inc. of Oklahoma. The gas will be produced through biogasification. It is estimated that the process will use approximately 90,000 tons of cattle manure each year to produce about 640 million cubic feet of methane. A sludge by-product produced in the process will be used as fertilizer which is more environmentally acceptable than raw cattle manure. (Merryman-East Central)

## 2324-A8, B5, D1, D3, E3

### WASTE CONVERSION CONCEPT DEVELOPED

Western Livestock Journal, Vol. 53, No. 30, p. 4, April 21, 1975.

Descriptors: *Recycling, *Aerobic conditions, *Bacteria, *Cattle, Odors, Humus
Identifiers: *Manure, *Soil conditioner

The BioCon Division of Searle Agriculture, Inc., at Summerfield, Texas uses an aerobic bacterial digestion process to transform cattle manure into a product called "Tilleez", which improves the tilth and fertility of soil. The product can be used on farmland without the problems of odor and burning associated with manure. The waste material is first pulverized by a grinder, then distributed in large vats and exposed to air for several days to promote growth of bacteria that converts the waste matter into a humus that can be applied safely to soil. It is estimated the plant will recycle approximately 150,000-200,000 tons of feedlot waste into soil conditioner each year. (Cameron-East Central)

## 2325-A9, A10, B5, C3

### FEEDING OF COUMAPHOS, RONNEL, AND RABON TO DAIRY COWS: LARVICIDAL ACTIVITY AGAINST HOUSE FLIES AND EFFECT ON INSECT FAUNA AND BIODEGRADATION OF FECAL PATS

Agricultural Environmental Quality Institute, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland
R. W. Miller and L. G. Pickens
Journal of Economic Entomology, Vol. 66, No. 5, p. 1075-1076, October 15, 1973

Descriptors: *Insecticides, *Dairy industry, *Feeds, *Larvicides, *Biodegradation
Identifiers: *Coumaphos, *Ronnel, *Rabon, *Fly larvae, Fecal pats, Insect fauna, Musca domestica L.

Results of experiments are reported comparing larvicidal activity against the house fly, the insect fauna of manure pats, and the breakdown of manure from cows fed coumaphos, ronnel, and Rabon. Eight dairy cows were fed a ration consisting of a concentrate mixture fed according to milk production, limited alfalfa hay pellets, and corn silage ad lib. Two of the eight cows served as controls and received no insecticide. The other 6 cows received insecticide supplements — two received coumaphos, two received Rabon, and two received ronnel. Larvicidal activity against Musca domestica L. was significantly greater in feces from cows fed Rabon than in feces from cows fed either coumaphos or ronnel. No residue of coumaphos or Rabon were found in the milk, but significant residues of ronnel were found. Results confirmed earlier experiments, which showed that as a candidate feed-additive larvicide for house fly control, Rabon was superior to either coumpophos or ronnel. Rabon and ronnel did not noticeably effect the biodegradation of pats of bovine feces in a pasture; coumaphos reduced tunneling by insects in the pats, but it did not reduce the amount of dry weight lost. (Cameron-East Central)

## 2326-A11, B2, D3, F3

### INDOOR LAGOON FOR POULTRY MANURE DISPOSAL

Assistant Professor of Poultry Husbandry, Nebraska Agricultural Experiment Station, University of Nebraska, Lincoln
W. J. Owings and J. L. Adams
Nebraska Experiment Station Quarterly, p. 16-17, Summer, 1961.

Descriptors: *Poultry, *Waste disposal, *Waste treatment, *Lagoons, Aerobic bacteria, Anaerobic bacteria

Because the trend in the poultry industry today is toward large, mechanized laying houses, disposal of manure has become a major problem. Because farmers generally prefer to buy a more concentrated commercial product for fertilizer and because many large poultry operators do not own enough land to efficiently dispose of the manure themselves, new alternatives must be found. The Poultry Department of the University of Nebraska is experimenting with an indoor lagoon which utilizes the intestinal bacteria of the bird to decompose the manure. A control pen has been set up which has a litter floor covered with wood shavings. The experimental pen has a full slat floor with a water-tight pit containing 630 cubic feet of water underneath it. 180 birds were housed in each pen as of October 15,1960. During the six months tested, egg production in the experimental pen has been about 4 percent higher than the control pen. The lagoon kept the experimental pen warmer during the winter. While the experimental pen has been operating very well, more information is needed concerning how much water is needed per bird and the proper temperature necessary to support adequate decomposition of the manure. (Merryman-East Central)

## 2327-A12, B4, C3

### PERSISTENCE OF SALMONELLAE IN POULTRY EXCRETA

Department of Environmental Science, Rutgers University, New Brunswick, New Jersey
J. H. Berkowitz, D. J. Kraft, and M. S. Finstein
Journal of Environmental Quality, Vol. 3, No. 2, p. 158-161, April-June, 1974.

Descriptors: *Poultry, *Salmonella, *Waste storage, *Storage requirements, Temperature
Identifiers: *Waste management

Precautions should be taken against the introduction of viable pathogenic microorganisms into the environment in the management of poultry wastes. Nontyphoid salmonellae are of special concern as they are pathogenic bacteria which affect humans and are commonly excreted by apparently healthy poultry. The object of this study is to observe the survival of salmonellae under conditions simulating storage in cage type poultry operations. A survey of commercial farms showed a range (for samples positive for Salmonella) in freshly voided specimens of from less than 1 to almost 35,000/g dry weight. The high value roughly corresponds to 7,000/g wet excreta. It would seem advisable to base storage guidelines on the higher end of this range to provide a wide margin of safety. As judged by a specific most-probable-number procedure, Salmonellae inoculated into samples of poultry excreta declined to very low numbers or disappeared within a month. However, the decline was usually preceded by a period of growth. This study provides a basis for estimating the length of time wet poultry excreta should be stored to insure acceptable Salmonellae densities, at temperatures representative of field conditions. An effective means of killing salmonellae is storage of undried excreta. (Kehl-East Central)

## 2328-B1, E3

### THE OIL CONVERSION PROCESS: AN ASSESSMENT

Agricultural Engineering, Vol. 53, No. 3, p. 20, March 1972.

Descriptors: *Recycling, *Oil, Livestock
Identifiers: *Agricultural wastes, *Conversion, Manure

S. S. De Forest reports on his visit to the Pittsburgh Energy Research Center, where the conversion of livestock manure and other agricultural wastes to low sulfur oil has become a reality. The scientists from the Research Lab suggest that the chemistry is basically simple: a process similar to the one used to convert coal to oil. Preliminary work suggests that the yield of oil is 40-50 percent or 3 barrels per ton of dry manure, the highest yield of any of the materials examined. De Forest feels that conversion plants for converting animal wastes to oil would be located to utilize cellulosic materials other than livestock wastes, ensuring that an economical supply of raw materials will continuously be available. The concept of converting livestock wastes to oil will require vast concentrations of livestock. This creates new problems in handling and managing vast numbers of animals and the products associated with them, such as feed, water and manure. (Cameron-East Central)

### 2329-B3, D2, E3
### CONVERTING ORGANIC WASTES TO OIL

Pittsburgh Energy Research Center,
U.S. Bureau of Mines,
Pittsburgh, Pennsylvania
H. R. Appell
Agricultural Engineering, Vol. 53, No. 3, p. 17-19, March, 1972. 2 fig, 1 tab.

Descriptors: *Recycling, *Organic wastes, *Oil, Cellulose, Cattle, Chemical properties
Identifiers: *Conversion, *Agricultural wastes, Carbon monoxide

The Bureau of Mines has successfully converted agricultural wastes, bovine manure, wood, urban refuse and sewage sludge to a low-sulfur fuel oil. The method requires reaction with carbon monoxide and water at temperatures of 300 degrees to 400 degrees C and pressures of 3000 to 4000 psig. Batch experiments on converting organic solid wastes to oil usually consist of placing the waste material in an autoclave, adding water and catalyst (if not present in the waste) and then adding carbon monoxide to the desired pressure. A continuous bench-scale unit to achieve this reaction is now in operation. The product from these continuous runs is a brownish-black oil at room temperature. Mass, infrared and ultravoilet spectrometric examination of the oil produced at 350 degrees C and 4000 psig indicates that the oil is mostly aliphatic with either linkages and carbonyl and hydroxyl groups present. Much of the material appears to exist in cyclic structures. (Cameron-East Central)

### 2330-C2, E3
### BRITISH GROUP ENCOURAGING WASTE RECYCLING

Feedstuffs, Vol. 47, No. 22, p. 32-33, June 2, 1975.

Descriptors: *Recycling, *Farm wastes, *Great Britain, Energy, Proteins
Identifiers: *Agricultural Wastes Processors Association, *Livestock wastes, Processing

The Agricultural Waste Processors Association encourages the processing, recycling, and recovery of all kinds of agricultural waste materials, including livestock manures, green vegetable waste and straw throughout the world. Animal wastes provide sources of energy, protein, phosphorous, copper and various other trace elements which are becoming increasingly scarce and expensive. Expressing views concerning processed wastes to the legislature, public and other associations is probably the main objective of the AWPA. AWPA hopes to encompass all persons and organizations interested in aspects of farm waste processing throughout the world. To keep those interested individuals in touch with developments and new applications for processed wastes, the association publishes a regular publication known as "The Waster." Anyone living in the U. S. interested in the recycling of wastes and in AWPA should contact the national secretary. (Cameron-East Central)

### 2331-B5, C1, C2
### NUTRIENT AND ENERGY COMPOSITION OF BEEF CATTLE FEEDLOT WASTE FRACTIONS

Agricultural Experiment Station,
Nebraska University, Lincoln
C. B. Gilbertson, J. A. Nienaber, J. R. Ellis, T. M. McCalla, T. J. Klopfenstein, and S. D. Farlin
Nebraska Agricultural Experiment Station Research Bulletin 262, July, 1974, 29 p. 2 fig. 10 tab, 27 ref.

Descriptors: *Nutrients, *Energy, *Cattle, *Feedlots, Nebraska
Identifiers: *Ration roughage

This bulletin describes nutrient and energy composition of beef cattle waste fractions as a function of the ration roughage level and type of feedlot. High- medium-, and low-roughage ration feces (HR, MR, LR) were collected from animals fed in metabolism crates. Thymal was mixed with these feces to prevent decomposition and mold growth. Samples were obtained from housed feedlot and outdoor feedlot cattle fed at the University of Nebraska Field Laboratory. Total solids content averaged 26.7 percent wb for high and low roughage ration feces, 19.3 percent wb for medium roughage ration feces, and 21.7 and 45.2 percent wb for manure from housed and outdoor feedlots, respectively. Volatile solids were 86.9 percent, 89.4 percent, and 93.9 percent db for feces from cattle fed high, medium, and low roughage rations. Manure from housed and outdoor feedlots were 85.8 percent and 24.0 percent volatile, respectively. The quantity of feces solids retained on sieves greater than 400 microns increased with decreased ration roughage content while those retained on sieves smaller than 400 microns decreased with ration roughage content. The ration fed did not significantly affect the gross energy of manure fractions or protein and fat contents of feces solid fractions. Nitrogen content increased with decreased ration roughage level and ranged from 0.61 to 4.75 percent. The ration roughage level did not have a predictable effect on the element concentration of the solids. (Cartmell-East Central)

### 2332-A6
### ODOR SENSATION THEORY AND PHENOMENA AND THEIR EFFECT ON OLFACTORY MEASUREMENTS

Associate Professor, Agricultural Engineering Department, Clemson University, Clemson, South Carolina
C. L. Barth
Transactions of the ASAE, Vol. 16, No. 2, p. 340-347, March-April, 1973. 5 fig, 1 tab, 45 ref.

Descriptors: *Odor, *Measurement, Temperature
Identifiers: Manure, Adaptation, Fatigue, Dilution, Gas-liquid chromatography

It was the purpose of this report to bring attention to procedures that might be employed for specific odor determinations and to highlight phenomena important in analysis of odor quality and intensity. A complete description is given of the human olfactory mechanism. Different theories of odor perception are discussed. Accurate characterization of an odor includes reference to its strength of intensity, and its quality. There is no commonly accepted stand — no point of reference — from which to judge odor quality. Limitations of odor testing result from the existence of the odor phenomena and the preferences of the observer. Adaptation is the adjustment to the odor stimulus and fatigue is the result of adaptation. Changes in odor quality sometimes occur due to dilution. The recommended temperature for odor testing is 40 degrees C. Mixtures, drugs, chemical reactions, contamination, the age, sex and smoking habits of the judge, natural variation and uncertainty are all factors that can enter into olfactory measurements. The gas-liquid chromatograph has been the most important instrument in supplementing the capabilities of the human nose in odor research. (Cartmell-East Central)

### 2333-A4,B2
### PHENOLIC ACIDS AS INDICATORS OF POLLUTION WITH LIQUID MANURE. A METHOD FOR THEIR DETECTION

Fishery Laboratory of the Agency of Environmental Protection, Charlottenlund, Denmark
O. Rump
Water Research, Vol. 8, p. 889-894, 1974. 3 tab, 8 ref.

Descriptors: *Pollutant identification. *Water pollution
Identifiers: *Phenolic acids, *Pollution indicators, *Liquid manure

This investigation is concerned with the development of a method to detect illegal liquid manure discharges. The method can be used to measure or detect water pollution. The investigation falls into two parts: 1. To find substances which are suitable indicators of liquid manure. 2. To develop an analytical method for the detection of such substances and test its application. M-hydroxybenzoic acid, m-hydroxyphenylacetic acid and m-hydroxyphenlypropionic acid in liquid manure occur in considerable quantities. They provide a sensitive analytical method for detecting liquid manure, even where this has been diluted considerably. A method for the detection of liquid manure is thin-layer chromatography on cellulose. The developed chromatograms are rendered visible by spraying with diazotized p-nitroaniline. By this method the minimum detectable amounts of the phenolic acids are approximately 0.01 ug. (Cartmell-East Central)

### 2334-A8, B4, B5, E2
### ORGANIC WASTE: ONCE NUISANCES, NOW RESOURCES

G. Sollenberger
The Furrow, p. 2-5, April 1975. 8 fig.

Descriptors: *Organic wastes, *Fertilizers, *Soil amendments, Reclamation, Nutrients, Costs, Erosion control
Identifiers: Application rates, Manure

The major problem with manure used to be how to get rid of it, but now it is how to get enough of it. The high prices and tight supplies of commercial fertilizers have made manure a much sought after fertilizer. The nutrient content of manure varies with age and ration of the livestock, the species of livestock and with how the manure is stored and handled. Doubtful farmers who once questioned the worth of hauling manure now discover they can use it to reduce production costs — and not by piddling amounts. An example is given. Researchers discovered in USDA studies at Manhattan, Kansas that animal waste was about as effective as anchored straw in slowing soil loss from a highly erosive sandy soil. Reclamation by building up non-productive land with sewage sludge has also been found effective in amending soils. The possibility of using some industrial organic wastes as a soil amendment is being examined as well. Use of organic wastes as fertilizers and soil amendments does have its problems. New pollution laws call for more intensive control of flies, odors and runoff. Application rates must be determined so that the manure will increase instead of decrease crop growth. Careful management is also needed in preserving the nutrients in manure. Finally, the problem of variability in the nutrient content of many wastes calls for additional attention. (Kehl-East Central)

## 2335-A1, A2, A7, B1, F2

### ENVIRONMENTAL PROTECTION GUIDELINES FOR DAIRIES

Agricultural Engineer, Texas Agricultural Extension Service, Texas A&M University, College Station
J. M. Sweeten
Mimeograph Publication, Texas Agricultural Extension Service, Texas A&M University, March 14, 1975. 7 fig.

Descriptors: *Legal aspects, *Regulation, *Dairy industry, *Waste management, *Texas, Permits, Water pollution control, Air pollution control
Identifiers: Runoff control, Sanitation

Proper site selection and facility design can minimize the water and air pollution from dairies. State and federal pollution control regulations greatly influence the design of dairy waste management systems. Such requirements for Texas dairies are given and explained. The major requirement for dairies to obtain permits from the Texas Water Quality Board is that systems be provided to prevent discharge from the premises. Generally, two systems are required: runoff control and manure management. Recommendations for these systems are given. Federal water pollution control regulations are also discussed. The Texas Air Control Board under the State Air Pollution Control Program has the authority to regulate odors from all dairies in the State under a general nuisance regulation. Permits and other regulations are required by the Texas Air Control Board and are explained. Dairy sanitation is under the Texas State Department of Health and milk inspection units of major Texas cities. Requirements for sanitation are listed. General Permit Procedures are discussed. (Kehl-East Central)

## 2336-A6, B2, B5, D3

### MUNICIPAL SLUDGE IN SWINE MANURE HELPS CONTROL ODORS

J. L. Roll, D. L. Day, and B. A. Jones, Jr.
Illinois Research, Vol. 16, No. 2, p. 14, 1974. 1 fig.

Descriptors: *Waste treatment, *Odor control, *Anaerobic digestion, Chemical oxygen demand, Degradation
Identifiers: *Swine, *Municipal sludge

A study was conducted to determine whether the addition of fresh non-lagooned municipal digester sludge to liquid swine manure would help initiate anaerobic activity and control odors. Three trials were conducted, utilizing five digesters in each trial. Trials 1 and 2 were batch digester tests, with digesters being loaded and allowed to run two weeks without addition or removal of material. Trial 3 was a 45-day study in which 1 liter of digester contents was removed each day and 1 liter of new material was added. In all trials, the five digesters contained the following ratios (on a volume basis) of liquid swine manure to municipal digester sludge: 2:1, 1:1, 1:2, 1:5, and 1:10. Anaerobic digestion was excellent in all trials. Digesters with 2:1 and 1:1 manure to sludge exhibited the best chemical oxygen demand and volatile solids reduction. A "sniffing" panel found the digester with 1:5 manure to sludge to have the least offensive odor. The digester sludge was valuable in establishing good anaerobic activity in manure. Consequently, manure was more rapidly degraded and odor was controlled. However, the best degradation was observed in the digester with the most odor. Some odor may have to be tolerated in order to achieve good optional reduction. (Merryman-East Central)

## 2337-A8, B1, D1, D2, E2, E3

### MANURE GETS RE-DISCOVERED

J. Goldstein
Compost Science, Vol. 15, No. 2, p. 24-27, March-April, 1974.

Descriptors: *Feedlots, *Fertilizers, *Livestock, *Costs, Energy, Nitrates, Dairy industry, Recycling
Identifiers: *Manure, *Land disposal

Several publications are listed which comment on the fertilizer shortages, antipollution laws, and the economics and methods for using manure. The fertilizer shortage may solve one major problem — economically disposing of large amounts of manure that accumulate at livestock markets. The best way to handle manure at the markets is to dehydrate it first. The dried product can be produced for just a few cents a pound. Farmers are now buying the raw manure to use in place of the nitrogen and phosphate they are finding hard to get. Just about any good commercial farmer who raises livestock as part of a mixed farming program returns manure to the land. Using the natural fertilizer produces a more iron-rich crop, compared to chemical fertilizers. (Cartmell-East Central)

## 2338-B2, E2, F1

### FOR THE SAKE OF YOUR NEIGHBORS—SLURRY INJECTION

London
A. Collier
Power Farming and Better Farming Digest, p. 21, 23, September, 1973. 3 fig.

Descriptors: *Slurries, *Equipment, *Costs
Identifiers: *Land disposal, *Soil injection

Researchers at Wageningen, Holland have developed a self-propelled tanker injector for control of the waste disposal problem. The machine is based on a Massey Ferguson 178 tractor. It provides a fast, effective, and low odor technique by use of a tanker with rear-fitted soil tines which slit the soil for injector tubes to place the slurry. A chopper pump takes the material from the tanker and makes lumps and fiber pass through tubes and injectors without blocking thus allowing working rates up to 40 tons an acre to depths of 12 inches. (Battles-East Central)

## 2339-A5, B1

### GROUND WATER POLLUTION PROBLEMS IN THE NORTHWESTERN UNITED STATES

Geraghty & Miller, Inc.
Port Washington, New York
Frits van der Leeden, L. A. Cerrillo, and D. W. Miller
Environmental Protection Agency Report No. EPA-3-75-018, 361 p. 60 fig, 48 tab, 176 ref.

Descriptors: *Ground water, Mine wastes, Salinity, Septic tanks, Water pollution, Water quality, Water resources, Waste dumps, Wells, Feedlots, Agricultural runoff, Northwestern United States, Colorado, Idaho, Montana, Oregon, Washington, Wyoming

An evaluation of ground-water pollution problems has been carried out in six states in the northwest: Colorado, Idaho, Montana, Oregon, Washington and Wyoming. The findings of the investigation indicate that, with the exception of radioactive waste disposal, few cases of ground-water pollution have been investigated in detail. There is a need for baseline water-quality data and systematic evaluation of overall ground-water conditions, especially in urban zones, in areas of petroleum exploration and development, and at locations of mining and industrial activity. The most common natural ground-water quality problems, other than high salinity, are excessive hardness, iron, manganese, and fluoride. Principal sources of man-caused ground-water quality problems in the approximate order of severity are: discharge of effluent from septic tanks and sewage treatment plants, irrigation return flow, dryland farming, abandoned oil wells, shallow disposal wells, unlined surface impoundments, mine tailings and mine drainage, municipal and industrial landfills, and radioactive waste disposal. Other sources that appear to be of less importance but still must be considered include: spills and leaks, application of fertilizers and pesticides, feedlots, and salt-water intrusion. (Scalf-R. S. Kerr Environmental Research Laboratory)

## 2340-A8, E2

### RESULTS FROM EXPERIMENTS MEASURING THE EFFECTS OF LARGE AMOUNTS OF FERTILIZER AND OF FARMYARD MANURE ON MAINCROP POTATOES GROWN IN SANDY SOIL AT WOBURN, BEDFORDSHIRE

Rothansted Experimental Station,
Harpenden, Herts
F. V. Widdowson, A. Penny, and R. C. Flint
Journal of Agricultural Science, Vol. 82, Pt. 1, p. 117-128, February, 1974. 2 fig, 12 tab, 7 ref. ref.

Descriptors: *Fertilizers, *Crop production, Nitrogen, Potassium, Phosphorus, Great Britain
Identifiers: *Manure, *Yields, Land disposal

By using both farmyard manure (FYM) and fertilizers, rather than fertilizers alone, the largest yields of potatoes were obtained in the Woburn Reference Experiment. The objective of this study was to find an explanation of this in experiments made on the coarse sandy loam found in Woburn. Four experiments were conducted during the period of 1968-1971 on Stackyard Field at Woburn, Beds. The soil was an acid sandy-loam overlying Lower Greensand. The study showed that FYM was less effective than fertilizer when given alone. The combination of fertilizer and FYM gave a larger yield than the double amount of fertilizer incorporated shallowly or a single amount of fertilizer. However, a smaller yield was obtained with the combination than with the double amount of fertilizer incorporated deeply, which gave the largest yield each year. In order to construct nutrient balance sheets, the NPK contents of the potato tubers were used. The balance sheets showed that large residues of N, P and K remained in the soil after harvest. FYM residues increased yields of both grain and straw while fertilizer residues increased only straw yields. When compared to freshly applied N, both kinds of residues were less effective, so most of the N leached during winter. The study also indicated that the yield of saleable tubers was increased by the double amount of fertilizer. (Kehl-East Central)

## 2341-B1

### MOST FLUME FLOORS SHORT ON ENGINEERING

Beef, Vol. 11, No. 9, p. 6-7, May, 1975. 4 fig, 1 tab.

Descriptors: *Safety factor, Flow rate, Waste dilution, Volume
Identifiers: *Flume floors, *Gutter design guidelines, Lagoon pumping

At a Cattle Feeders Seminar in Columbia, Missouri, the engineering of flume floor systems was examined. Bob George, University of Missouri agricultural engineer, claims that some of the flush-type buildings he has seen operate on the "brink of disaster". He states that most current flume-type floors just don't have a large enough safety factor designed into the flumes. Two Missouri feeders, Lewis Wilson and Ed Gunnels discussed their systems and admitted that although they're not the safest, they do the job. A table containing recommendations for gutter design dimensions is provided and is based on gutters eight inches wide. Mr. George also gave a few recommendations about the lagoons hooked onto flushing systems. These are listed, and are applicable primarily to Central Missouri. (Kehl-East Central)

## 2342-A11, A12, B2, D3, E3

### RECYCLING SWINE WASTE AS FEED

Department of Animal Science,
Illinois University, Urbana
B. G. Harmon and D. L. Day
Illinois Research, Vol. 15, No. 3, p. 14-15, Summer, 1973. 2 fig, 6 tab.

Descriptors: *Recycling, Proteins, Amino acids, Health
Identifiers: *Refeeding, *Swine, *Oxidation ditch mixed liquor (ODML)

About 300 hogs have been fed in oxidation ditch mixed liquor (ODML) studies over the past three years in an attempt to minimize pollution and to take advantage of the protein and amino acids that ODML has to offer. Representative samples of all the hogs have been slaughtered and inspected for liver or lymphatic tissue changes. No changes attributable to the feeding of ODML have been found in the slaughtered animals. All carcasses have passed meat inspection. Actual descriptions of the studies are given. (Merryman-East Central)

### 2343-A6, A11, A12, E3
### AG ENGINEERS REVIEW NEW WASTE MANAGEMENT SYSTEMS
Feedstuffs, Vol. 47, No. 17, p. 6, 74, April 25, 1975.

Descriptors: *Poultry, *Nutrients, Additives, Health
Identifiers: *Refeeding, Dehydrated poultry waste

At the American Society of Agricultural Engineer's Symposium on Livestock Wastes, held at the University of Illinois, the management of poultry and livestock wastes was examined from an agricultural engineer's viewpoint. A demonstration project at the Michigan State University was described by Dr. M. L. Esmay of MSU as an attempt to obtain design and management information for the optimum handling of wastes from a commercial-sized cage-type layer house. The objective of the program was to study the management of poultry excreta in a closed environmental ecological system including the production of dehydrated poultry waste (DPW) for feeding, odor abatement and pollution control. From the study, several significant results were noted and listed by Dr. Esmay. Dr. Robert G. Yeck of the U. S. Department of Agriculture's Agricultural Research Service discussed the existing opinions and potentials for using nutrients from animal wastes in feed. Dr. Yeck stated that there are potential adverse effects from feed additives and inadvertent contaminants that must be recognized. He also listed the constraints to implementation of the various systems. These are: animal acceptability, utility, animal product safety and consumer acceptance. R. D. Glock and K. J. Schwartz of Iowa State University said that the design of these facilities should include consideration of the potential disease hazard. (Kehl-East Central)

### 2344-B2, B3, D1, E3
### SEPARATING SOLID WASTE FROM LIQUID
Managing Editor, Feedlot Management
G. Ashfield
Feedlot Management, Vol. 17, No. 5, p. 6-8, May, 1975. 3 fig.

Descriptors: *Solid wastes, *Liquid wastes, *Cattle, *Recycling, Feeding rates
Identifiers: *Separation, *Refeeding, Confinement housing

At the Kissinger integrated cattle operation near Fairfield, Nebraska, 60-70 tons of manure, produced by steers housed in their 1,110 head slope-slat, flush barn, are retrieved and recycled into dried waste material which will be put to use as one of the ingredients in dry cow ration. The recycled wastes are mixed with stalklage from the cropping program at a ration of 4:3. The 60-70 tons of solid waste is screened from the liquid produced in the Kissingers' cold confinement barn. The Kissingers run cows in two herds of approximately 300 cows each for spring and fall calving in a semi-confined, drylot area. This lends itself well to feeding to the nutritional requirements of the various stages of the yearly cow cycle, artificial insemination and overall management of the cow herd. (Cameron-East Central)

### 2345-A11, A12, C2, C3, E3, F2
### RECYCLING NUTRIENTS FOR LIVESTOCK
Animal Science Department, Mississippi State University, Mississippi State, Mississippi
H. W. Essig
Feedstuffs, Vol. 47, No. 21, p. 35, 43, May 26, 1975. 19 ref.

Descriptors: *Recycling, *Poultry, *Regulation, *California, *Mississippi
Identifiers: *Refeeding, *Dried poultry waste, *Food and Drug Administration, *Health

Scarcity of land for manure disposal and concentration in poultry production are causing waste disposal problems. Methods other than land disposal are needed. Many poultry producers are turning to recycling dried poultry wastes as feed. Dried poultry waste appears to be the waste material that has the greatest potential as a feedstuff because it is high in crude protein, normal in minerals and negative to aflatoxins and salmonella. The states of California and Mississippi have moved ahead independently in sanctioning the use of dried poultry waste (DPW) in feedstuffs. The Food and Drug Administration is in the process of restating its position on the use of recycled nutrients in livestock feeds, and these regulations should be published in the near future. Before recycled nutrients from poultry operations can be used as a feedstuff, state and FDA regulations must be set forth to insure a standardized product that is not harmful when fed to animals. The poultry producers must make an effort to control the quantities of copper, arsenic, selenium and other heavy metals, as well as any drugs that might appear in the recycled nutrient materials. (Merryman-East Central)

### 2346-A6, A8, B1, C2, E2
### CONSEQUENCES OF WASTE DISPOSAL ON LAND
Research Soil Scientist, Agricultural Research Service, USDA, Professor of Soils at the University of Minnesota
W. E. Larson, J. R. Gilley, and D. R. Linden
Journal of Soil & Water Conservation, Vol. 30, No. 2, p. 68-71, March-April, 1975. 1 fig, 4 tab, 22 ref.

Descriptors: *Waste disposal, *Organic wastes, *Sewage sludge, *Sewage effluents, Reclamation, Productivity, Crop response, Wind erosion
Identifiers: *Land disposal, *Manure, Pollution

Organic wastes can be used safely and effectively to increase soil productivity if proper precautions are taken concerning heavy metals, toxic chemicals, nitrate leaching, erosion losses, and undesirable odors. Average composition is given for animal wastes (dairy cattle, beef cattle, swine and poultry hens), sewage sludge and secondary sewage effluent. Farm manures contain the major nutrients in the most correct proportion for soil fertilization. They also decrease bulk density, increase aggregate stability, increase water intake rates, and help control soil erosion. Sewage sludges have proved effective in reclaiming such productive land as mine spoil banks, wastes from a soda glass factory, dune and dredged sands, and abandoned garbage dumps and sanitary land fills. There is also evidence that crop yield increases as the result of irrigation with treated municipal wastewater. It must be emphasized that proper waste management measures must be taken to protect the environment. When applied at crop use rates and with proper soil management, most organic wastes present no serious environmental hazards and should be considered a resource that agriculture can very well use. (Merryman-East Central)

### 2347-A3, A4, C3
### CONCENTRATIONS AND CYCLES OF BACTERIAL INDICATORS IN FARM SURFACE RUNOFF
Research Hydrologist, Agricultural Research Service, U.S. Department of Agriculture
S. H. Kunkle
In "Relationship of Agriculture to Soil and Water Pollution," Cornell University Conference on Agricultural Waste Management, Rochester, New York, 1970, p. 49-60. 7 fig, 2 tab, 27 ref.

Descriptors: *Water pollution, *Agricultural runoff, *Coliforms, *Animal wastes
Identifiers: *Bacterial indicators, *Feces

Adequate surveillance techniques for detecting animal waste contamination of streams are essential if water pollution is to be avoided. This report describes initial results from a study of bacterial pollution indicators on the Sleepers River Watershed, Danville, Vermont. During periods of storm runoff from the watershed concentration of total and fecal coliforms rose drastically, with distribution of the values closely related to the hydrograph. Total coliform concentrations in runoff from the hayfield (unsubjected to farm animal wastes) were similar to concentration in runoff from the partially grazed 0.75 sq km watershed, making use of total coliform data of questionable value for pollution surveillance within the rural watershed. To the contrary, the fecal coliform densities were much greater in the partially grazed watershed's runoff than in the hayfield's. Evidently the more specific coliform group is a much better pollution indicator for the conditions of the study. The percentage of total coliforms that were fecal types was much higher in the watershed runoff than in the hayfield runoff. This study emphasizes that the hydrologic processes are of extreme importance in reference to use of indicator organisms. These hydrologic and physical relationships need to be well described if water quality inputs in streams are to be successfully modeled. (Cartmell-East Central)

### 2348-D2, E3, F1
### ULTIMATE IN RECYCLING
Chemical Week, Vol. 113, No. 12, p. 16, September 19, 1973.

Descriptors: *Recycling, *Feeds, *Reclamation, Economics, Feedlots, Chemicals, Colorado, Cattle
Identifiers: *Refeeding

This article discusses a 200-head pilot project to feed steers recycled manure begun recently by Ceres Land, Sterling, Colorado, a major cattle feeding company. The company expects to have the system in "full commercial operation" by January 1, 1974, and intends to sign joint venture agreements with feed lots. One of the developers of the process estimates that the feed will cost less than one-third the price of conventional materials and that the technique poses no pollution problems, leaving only residues of clean-water vapor and five percent ash. The recycling process is described. Although the process is expected to require large amounts of chemicals, the manufacturers of cattle feed additives and the producers' trade associations do not see any major effect on sales of their products. (Solid Waste Information Retrieval System)

### 2349-A11, C2, E3
### RECYCLING POULTRY LITTER AS SILAGE
C. R. Creger
Poultry Digest, Vol. 34, No. 400, p. 256, June, 1975.

Descriptors: *Recycling, *Silage, *Cattle, Weight, Taste
Identifiers: *Poultry litter, Broiler litter

Early results from a Texas A&M University program of recycling poultry litter as silage for beef cattle are favorable. Each of four groups of birds was fed a standard broiler diet containing 19-24 percent protein for 8 weeks. Water was added until the total moisture content was 35-38 percent. Fifteen heifer calves, each weighing about 477 pounds, were placed on a feeding regimen that consisted of broiler litter silage free-choice. Eight pounds per head of a 12 percent protein mixture were poured over the silage daily. Results of the tests showed the calves gained an average of 2.54 lbs per head per day when fed the broiler litter silage free-choice, along with the 12 percent protein mix for a period of 120 days. A trace mineral analysis indicated the silage was an excellent source of calcium, phosphorus, and other trace elements. A 50 member panel detected a small but significant difference in taste between steak from the treated and nontreated animals. All steaks received acceptable scores in taste, but the panel expressed a preference for steak from nontreated control. (Cameron-East Central)

### 2350-A11, E3, F1
### CATFISH ON DPW
Poultry Digest, Vol. 34, No. 398 (4), p. 30, April, 1975.

Descriptors: *Catfishes, *Diets, *Performance, *Taste, Costs
Identifiers: *Dried poultry waste

An experiment was conducted to study the effects of feeding dried poultry waste to catfish. Each of three ponds were stocked with 150 channel catfish fingerlings. Pond 1, which was fed a control diet containing fish meal and poultry by-product meal as sources of animal protein, had 136 fish at harvest. Average gain was 0.51 pound from the initial stocking rate of 0.25 pound. Pond 2, which was fed a diet containing 25 percent air-dried poultry waste and sources of animal protein, had 139 survivors. Average gain was 0.67 pound from an initial weight of 0.20 pound. Pond 3 was fed a diet containing 25 percent air-dried poultry waste and no source of animal protein. There were 139 survivors, and the average gain was 0.67 pound from an initial weight of 0.20 pound. Cost of the ration was reduced approximately $24 to $30 by substitution of dried poultry waste for animal protein ingredients. A higher percentage of the taste panel expressed a dislike for the catfish receiving the control ration which contained no air-dried poultry manure. (Merryman-East Central)

### 2351-B1, B2, B3, B4, E2
### EXPERIMENTAL FACILITIES FOR STUDIES ON BEEF HOUSING AND EQUIPMENT
Department of Agricultural Engineering,
North Dakota State University, Fargo
R. L. Witz and G. L. Pratt
Canadian Agricultural Engineering, Vol. 13, No. 2, p. 81-84, December, 1971. 9 fig, 4 tab, 4 ref.

Descriptors: *Confinement pens, *Cattle, *Design, *Waste disposal, *Waste storage, *Equipment, Slotted floors, Ventilation, Liquid wastes, Solid wastes, Lagoons
Identifiers: *Waste management, Land disposal

Studies were conducted to develop improved feed handling systems, manure disposal facilities, and ventilation equipment for beef confinement housing. To study these problems, a test facility was built in which two units, each capable of holding a block of 20 feeder calves, were incorporated. The design of the west half of the facility had a sloping concrete floor installed in a shallow pit below a slotted floor. The liquids were drained south in the direction of the slope and were pumped to a lagoon. The solids were scraped north with a cable-scraper and conveyed out of the building at frequent intervals. The ventilating system utilized double fans, using a fan and heat sink on both the intake and exhaust. The design of the east half of the facility was a conventional system using a slotted floor with a deep-pit manure storage. Manure was removed in a slurry form on a semi-annual basis and spread on farm fields. The ventilating system was patterned after one commonly used in greenhouses and continually circulated the air to maintain uniform temperature. (Cartmell-East Central)

### 2352-A8, C2, E2
### DAIRY CATTLE MANURE — IT'S EFFECT ON RYE AND MILLET FORAGE YIELD AND QUALITY
USDA, Auburn University Agricultural Experiment Station, Auburn, Alabama
A. F. Lund, B. D. Doss and F. E. Lowry
Journal of Environmental Quality, Vol. 4, No. 2, p. 195-198, March-April, 1975. 7 fig, 2 tab, 9 ref.

Descriptors: *Dairy industry *Waste disposal, *Crop response, *Soils, Nitrogen, Nitrates
Identifiers: *Land application, *Application rates, *Dothan loamy sand, *Lucedale sandy loam, *Rye, *Millet

A study was conducted to evaluate the effects of various rates of manure applications on forage yield and quality of rye and millet, double-cropped on two different soils—Dothan loamy sand at Auburn, Alabama and Lucedale sandy loam at Thorsby, Alabama. In general millet and rye on both types of soils produced good forage with rates of dairy cattle manure of 22.5 and 45 metric tons/ha incorporated into the soil. Organic nitrogen increased as manure application rate increased up to the 180 metric tons/ha rate on Lucedale soil. Nitrogen content was higher for rye than for millet for a given treatment and soil, and tended to be higher on Dothan than on Lucedale for any one treatment and crop. Nitrate content was also higher on Dothan than on Lucedale. Both millet and rye had nitrate contents above 2 percent when 180 and 270 metric tons/ha of manure were applied. Most treatments produced tetany-prone forage that contained K/(Ca + Mg.) ration above 2.2. The forage produced with high rates of manure on Lucedale soil had higher K/(Ca + Mg) ratios than did that of Dothan soil with equal rates of manure application. $NO_3$ was higher in the forage of the Dothan soil when high rates of manure were used. (Cartmell-East Central)

### 2353-C1, C2, E2, F1
### POULTRY LITTER'S VALUE AS FARTILIZER CITED BY GEORGIAN
Feedstuffs Southeastern Correspondent
R. H. Brown
Feedstuffs, Vol. 47, No. 24, p. 6, 44, June 16, 1975.

Descriptors: *Poultry, *Litter, *Fertilizers, Moisture, Nutrients, Georgia
Identifiers: Manure

Harry D. Muller, Georgia extension poultry specialist, told poultrymen and cattlemen that poultry litter may have excellent value as a fertilizer. He reported that for each ton of feed, 2,500 lb. of fresh manure is produced from a flock of birds. Muller found that fresh caged hen manure, with 37% moisture, can have a value of $25 a ton when the plant nutrient values are added up. Nitrogen losses can be reduced in ventilated, well-insulated houses and by using litter materials which can rapidly dry the manure. Muller recommends no more than two tons of dry or six tons of fresh manure per acre, on fields manured every year. (Cameron-East Central)

### 2354-A9, A10, A11, C2
### HORN FLIES, STABLE FLIES, AND HOUSE FLIES: DEVELOPMENT IN FECES OF BOVINES TREATED ORALLY WITH JUVENILE HORMONE ANALOGUES
U. S. Livestock Insects Laboratory,
Agricultural Research Service, USDA,
Kerville, Texas
R. L. Harris, E. D. Frazer, and R. L. Younger
Journal of Economic Entomology, Vol. 66, No. 5, p. 1097-1098, October 15, 1973, 3 tab, 3 ref.

Descriptors: *Toxicity, *Additives, *Cattle
Identifiers: *Horn flies, *Stable flies, *House flies, *Juvenile hormone analogues

Seven tests were conducted at the U.S. Livestock Insects Lab in 1972-73 with 3 juvenile hormone analogues used as feed additives for control of the horn fly, the stable fly, and the house fly. Results indicate that Ro 7-9767 effectively inhibited development of horn flies and stable flies in the manure of the treated animal. When Ro 7-9767 was tested at the lower dosages, 1 g/day was the minimum dose that completely inhibited development of stable flies and horn flies. Development of stable and horn flies was inhibited in the manure of cattle treated with ZR-315. ZR-515 was the most active compound tested, since 0.7 mg/animal per day completely inhibited development of horn flies and 100 mg/animal per day completely inhibited development of stable flies. This compound did not completely inhibit development of house flies. When RO-20-3600 was mixed with the feed, 5 g/day inhibited development of horn flies and stable flies but not of house flies. No signs of clinical toxicity were observed in the cattle. (Cartmell-East Central)

### 2355-A8, A9, B2, D3, E2
### SWINE WASTE MANAGEMENT
L. E. Hanson, J. MacGregor, H. Chiang, P. R. Goodrich and R. E. Larson
1973-1974 Minnesota Swine Research Reports, Preliminary Report H-240, Department of Animal Science in Cooperation with Agricultural Extension Service and Agricultural Experiment Station, University of Minnesota, 1973, p. 39-43. 2 tab.

Descriptors: *Crop response, *Corn, *Fertilizers, *Liquid wastes, *Pesticides
Identifiers: *Swine, *Waste management, *Land disposal, *Application rates, *Port Byron silt loam, *Waukegan silt loam

An extensive project on animal waste management was established in the Agricultural Experiment Station in 1970. Studies were then initiated at the Branch Stations in Crookston, Grand Rapids, Morris and Waseca. In 1972 a study of swine waste management was initiated at the Agricultural Experiment Station at Rosemount on two soil types. Liquid swine wastes from the anaerobic pits of growing-finishing buildings were applied at two rates in the fall of 1972. Corn was grown on these plots in 1973. The swine waste produced a remarkable increase in corn yields on one site (Port Byron silt loam) and had little effect on corn yields on one second site (Waukegan silt loam). The contrasting results are tentatively attributed to the previous cropping history of the sites. The study will be continued on 1974. (Hanson, et al.-Minnesota University)

### 2356-A8, A9, B2, E2
### SWINE WASTE MANAGEMENT
L. E. Hanson, J. MacGregor, H. Chiang, P. R. Goodrich, R. C. Munter, and R. E. Larson
Continuation Report of 1973-1974 Minnesota Swine Research Reports, Preliminary Report H-240, Department of Animal Science in Cooperation with Agricultural Extension Service and Agricultural Experiment Station, University of Minnesota, 1974, 2 p. 2 tab.

Descriptors: *Crop response, *Corn, *Fertilizers, *Liquid wastes, *Pesticides
Identifiers: *Swine, *Waste management, *Land disposal, *Application rates, *Port Byron silt loam, Waukegan silt loam

This is a continuation report of Preliminary Report H-240 of the "Minnesota Swine Research Reports, 1973-74." Following the 1973 corn harvest, the test plots were cleared and cored soil samples were taken. The plots were then treated with wastes from the anaerobic pits of growing-finishing buildings with application rates of none, 200 and 400 tons per acre. Corn was planted on May 17. Growth was terminated at the Waukegan site on September 3 and at the Port Byron site on September 21 by frost. The 1974 growing season had a wet spring followed by poorly distributed and inadequate rainfall. Consequently, total corn dry matter and grain yields were reduced. Total dry matter production varied from 93 to 97 percent of 1973 yields on the fertilized Port Byron plots and from 80 to 87 percent on the fertilized Waukegan plots. Corn yields varied from 70 to 80 percent of 1973 yields on the fertilized Port Byron plots and from 51 to 71 percent on the fertilized Waukegan plots. The pesticide (Furadan) applied at planting time apparently had little or no effect on corn yields of the Port Byron plots fertilized with swine waste. The pesticide had more effect in increasing corn yields on the Waukegan than on the Port Byron soils. (Merryman-East Central)

## 2357-D3

### MICROBIAL NITRIFICATION AND DENITRIFICATION IN CONCENTRATED WASTES

Research Associate, Agricultural Waste Management Program, Cornell University, Ithaca, New York
T. B. S. Prakasam and R. C. Loehr
Water Research, Vol. 6, p. 859-869, 1972. 7 fig, 1 tab, 12 ref.

Descriptors: *Microbial degradation, *Waste water treatment, *Agricultural wastes, *Poultry, *Nitrification, *Denitrification, Municipal wastes

In view of the reported feasibility of microbial nitrification-denitrification methods for the removal of nitrogen from municipal waste, an experimental study was undertaken utilizing continuous flow and batch studies to obtain fundamental information on the applicability of such a method for the control of nitrogen from a concentrated agricultural waste. It was found that solids retention time values greater than 2 days sustained nitrification. Loading factors greater than 0.15#COD day -1#MLVSS-1 resulted predominantly in nitrite formation. Even at pH 5, nitrification was sustained. Free $NH_3$-N concentrations greater than 0.02 mgl-1 hindered nitrate formation resulting in nitrite predomination. $NO_2$-N had higher denitrification rates than $NO_3$-N. Denitrification of nitrified waste was accomplished without controlling pH. After the nitrified waste was denitrified, residual ammonia was left in the mixed liquor. A second nitrification of this denitrified mixed liquor resulted in complete oxidation of the residual ammonia. (Cartmell-East Central)

## 2358-A1, E2

### INDUSTRIAL WASTE AND AGRICULTURE IN GLAMORGAN

ADAS, Glamorgan
B. Rees
Agriculture (London), Vol. 78, p. 126-128, 135, 1971

Descriptors: *Industrial wastes, *Agriculture, *Reclamation, Sewage, Swine, Poultry
Identifiers: *Glamorgan

The restoration of former industrial land and the use of certain industrial by-products are helping agriculture in Glamorgan. 12,700 acres of opencast coal land has been restored for agricultural purposes and afforestation. Power station pulverised fuel ash is being used for motorways and as filler material for quarries, land depressions, and cut down woodland. Treated sewage water is being channeled to grasslands and solid sludge is a useful supplement to inorganic fertilizers on farms. Sawdust and wood shavings are being used as bedding in many agricultural areas. Disposal of lime-soda sludge on acid coal measure uplands is being considered for its ameliorative effect on grassland improvement. Swine and poultry manures are being used in the restoration of opencast coal land and derelict colliery tips. These are examples of ways that "wastes" can be put to use, particularly in the reclamation of derelict land. (Cartmell-East Central)

## 2359-A10,B1,B2,B3,C2,C3, D2,D3,E2,E3,F1,F4

### ANIMAL WASTE IN THE U. S. A.

Poultry Husbandry Adviser,
A.D.A.S., Worcester
B. Hodgetts
Agriculture, Vol. 79, p. 98-103, 1972. 3 fig.

Descriptors: *Animal wastes, *United States, Aerobic treatment, Poultry, Lagoons, Degradation
Identifiers: *Pollution, *Land spreading, Anaerobic treatment, Duck wastes, 'Bressler' system, Composting, Dehydrated poultry wastes, Fly larvae

This survey of American practice by an Englishman observes that "land spreading is still, of course, generally the cheapest, most efficient and most popular means of disposing of animal manures, but the economic cost of doing this may in some cases be so high as to make the system unattractive." Aerobic treatment of liquid wastes has advantages; its problems are foaming, sedimentation and high running costs. Aerobic treatment of solids by the "Bressler system (fan aeration in pits beneath cages) involves high capital costs. Composting is ineffective on poultry manure alone and, thus, involves blending with some other waste source. Anaerobic lagoons work admirably in the climate of Southern California with lagoon water being recirculated for flushing. Nutrient recycling and manure degrading with fly larvae are discussed. Fly larvae hold great promise in that "the activities of the young larvae aerate and successfully deodorize the manure in 2-3 days and remove 50 percent of its moisture. The larvae are allowed to pupate and when dried and ground the pupae may be used as a protein source for the growing chick. The remaining manure may be further dried or pelleted and can be used as a soil conditioner or fertilizer, or even as a feed for catfish. The manure from 100,000 hens is expected to produce between 500 and 1000 lb of pupae meal daily." (Whetstone, Parker, & Wells-Texas Tech University)

## 2360-B1, C1, C2, D3, E3

### MANURE SMELL FURNISHES FARMSTEAD'S POWER NEEDS

Eikenhof, Nr. Johannesburgh, South Africa
L. J. Frey
National Hog Farmer, Vol. 6, No. 3, p. 35-36, March 1961

Descriptors: *Gases, *Fertilizers, *Anaerobic digestion, *Recycling
Identifiers: *Manure, *South Africa

The use of dung to produce gas for furnishing a farm's power needs is discussed. A mixture of dung and water is placed in a digestor, where it is attacked by methane bacteria. The digestor is large so that the maintenance of the bacterial state is ensured — the contents being always alkaline. The process did not cause the decomposed dung to lose its fertilizing value; rather it was greatly improved. An analysis of the sludge showed that there was 10 percent dry matter, of which 5 percent was phosphates, 6.4 percent nitrogen, and 1 percent potash. There are some disadvantages to this system. Anaerobic decomposition generates no heat. Although heat must be applied, this can be done simply, without running cost. Alternatively, the gas can be used directly as it comes. Mr. Frey states that the gas is a very clean fuel. The wear is negligible and the sparking plug requires "tapping in" only once a month. Figures are given on the BTU obtained from the gas. The figures show the immense potential power available from dung, far greater than the heat available from burning dried droppings, and yet leaving the product as a fertilizer. (Kehl-East Central)

## 2361-B2, C2, D3

### THE FATE OF NITROGEN AND PHOSPHORUS IN AN OXIDATION DITCH TREATING SWINE WASTES

Professor of Civil Engineering,
Toronto University, Toronto 181, Canada
P. H. Jones and N. K. Patni
Presented at 45th Annual Conference, Water Pollution Control Federation, Atlanta, Georgia, October 12, 1972. 34 p. 16 fig, 4 tab, 20 ref.

Descriptors: *Nitrogen, *Phosphorus, Nitrification
Identifiers: *Swine, *Oxidation ditch, *Waste treatment, Wood shavings

Studies were made on the fate of nitrogen and phosphorus during a seven-month study of a full-scale oxidation ditch and a one-acre lagoon system that was used to treat the daily wastes from about 410 swine in the finishing barns of a hog breeding farm located 35 miles north of Toronto, Ontario. The cumulative total Kjeldahl nitrogen loading lost by the ditch mixed liquor (DML) was about 80 percent after 20 weeks and about 50 percent after 30 weeks of operation. Introduction of wood shavings in the DML appeared to inhibit nitrogen removal during the later stages. Conditions of pH, temperature, dissolved oxygen distribution of the DML and the daily load led to the conclusion that nitrogen removal was mainly by nitrification-denitrification sequence. About 15 percent of the phosphorus loading of the oxidation ditch was lost. It was presumed to have been absorbed on the loam soil beneath the unlined bottom of the ditch. (Cameron-East Central)

## 2362-A8, C2, D3, E2, F6

### NITRATE MOVEMENT IN SOIL UNDER EARLY SPRING CONDITIONS

M. F. Walter
Ph.D Thesis, University of Wisconsin, 1974, 147 p. 35 fig, 16 tab. 108 ref.

Descriptors: *Farm wastes, *Water pollution sources, *Frozen soils, *Fertilizers, *Leaching, *Path of pollutants, *Nitrates, *Soil water movement, Nitrogen, Soil profiles, Dispersion, Absorption, Computer models
Identifiers: Pasture management

Physical transport mechanisms and chemical transformations of nitrogen were investigated and a quantitative mathematical model was developed of manurial nitrogen movement through soil profiles under typical early spring conditions. Nitrogen transformation studies were conducted with batch systems of Plainfield sand and anaerobic dairy waste. Laboratory soil columns were used to investigate flow and transport processes. The specific conditions studied were temperatures from 0 to 20 degrees C, soil moisture from 5 to 20 percent by dry soil weight, soil pH from 6 to 8, and aerobic soil environment. The quantity of nitrate in an incremental volume of soil depended upon its movement in or out of the soil volume due to mass flow of water and to the net production of nitrate within the volume of soil due to mineralization of organic nitrogen and nitrification of ammonium. Nitrate accumulation as predicted by the computer model was based on nitrification of added manurial ammonium and soil nitrogen mineralization. Estimates of solute dispersion were made based on the movement of the soil water after infiltration. Laboratory soil columns incubated at different temperatures and with differing volumes of infiltration were used to simulate field soil conditions resulting after heavy land applications of anaerobic liquid dairy waste. Nitrogen measurements from these soil columns were compared with predictions from the computer model. (Selected Water Resources Abstracts)

## 2363-B3,C1,C2,D3,E2,F6

### ACTIVATED-SLUDGE STABILIZATION OF SWINE WASTE

R. E. Hermanson
Unpublished Ph.D. Dissertation, Iowa State University, Ames, 1967, 102 p. 16 fig, 8 tab, 11 ref.

Descriptors: *Mathematical models, *Activated sludge, *Aeration, Waste treatment, Nitrification, Biochemical oxygen demand, Suspended solids
Identifiers: *Swine

This study is concerned with the stabilization of swine waste by the extended-aeration, activated-sludge process. The major objectives of the study were: (1) to develop a mathematical model for the BOD-reduction efficiency of the system, and (2) to verify the model and evaluate its coefficients by conducting experiments with a laboratory-scale system. The model's operation and performance were generally satisfactory. For most of the study, the mixed liquor pH remained in the optimum range for biological growth and the influent waste had adequate nitrogen and phosphorus for a proper nutritional balance. The activated sludge was odorless, flocculent, and settled well. Denitrification and foaming were not a problem. The reduction of BOD and suspended solids were satisfactory and there was a high degree of nitrification. An occasionally excessive discharge of suspended solids was caused by sludge bulking in the sedimentation. Provided the flow rate does not vary widely, excessive solids losses because of denitrification can be avoided by proper design of the sedimentation unit. The successful fitting of the mathematical model to the data was achieved by a non-linear, least-squares method that used a trial and error solution based on Hartley's modification of the Gauss-Newton method. Because extended-aeration, activated-sludge required less land than field spreading or lagooning, is essentially odor free, does not attract flies, and provides a high degree of BOD reduction, this system may be a desirable waste management alternative for the swine producer. (Kehl-East Central)

## 2364-B2, D3, E3, F1

### BIO-GAS DISPOSAL SYSTEM NOT ON

Soil and Water, Vol. 19, No. 2, p. 47, December, 1973.

Descriptors: *Methane, *Costs, Anaerobic digestion, Effluent
Identifiers: *New Zealand, *Piggeries, *Bio-gas plant

A New Zealand study shows that the benefit from a bio-gas pig effluent disposal system would most probably not outweigh the costs of the system. Only industrialized countries with limited water supplies have high standards of industrial treatment. Heavy fines for failure to comply would therefore make a bio-gas treatment system economical. Since New Zealand generally has enough land and water for pig wastes to be discharged after 80-90 percent of the pollutant matter has been removed, it was advised that traditional treatment forms be maintained. (Kehl-East Central)

## 2365-A11, B2, C3

### SURVIVAL OF CERTAIN PATHOGENIC ORGANISMS IN SWINE LAGOON EFFLUENT

Department of Veterinary Pathology,
Iowa State University, Ames
R. D. Glock, K. J. Vanderloo, and J. M. Kinyon
Journal of the American Veterinary Medical Association, Vol. 166, No. 3, p. 273-275, February 1, 1975. 1 fig, 2 tab, 12 ref.

Descriptors: *Lagoons, *Effluent, *Salmonella, *Anaerobic conditions, Sampling
Identifiers: *Pathogens, *Swine, *Survival, *Dysentery

This study involved 2 trials. In each trial, 3 pigs had access to plain water and 3 pigs were fed lagoon effluent. These pigs came from a closed herd with no evidence or history of salmonellosis or swine dysentery. Rectal swabs, necropsies, and samples of lagoon effluent were studied. Information obtained from these studies indicates that effluent from an anaerobic lagoon may be a source of infectious organisms. Salmonella spp were isolated from lagoon effluent as well as from the feces and tissues of pigs that drank the effluent as a sole source of water. All cultures submitted for typing were identified as *S.* saint-paul, of which the pathogenicity is unknown. Clinical signs typical of swine dysentery and enteric shedding of large numbers of spirochetes with the characteristics of Treponema hyodysenteriae were noted in 5 of the 6 pigs. Further study is needed to determine how long infectivity persists and whether there is growth of Salmonella spp, T hyodysenteriae, or other pathogens in the effluent. (Merryman-East Central)

## 2366-A4, A5, A8, B1, C2, E2

### SWINE MANURE LAND APPLICATION RATES

Hog Farm Management, Vol. 9, p. 32-33, February 1972. 1 tab.

Descriptors: *Waste disposal, Nitrogen, Indiana, Water pollution
Identifiers: *Swine, *Land disposal, *Loading rates, Salt buildup

Land application of swine manure is recommended as a means of protecting surface and ground water from nitrogen and phosphorus excesses, of removing bacteria and pathogens through the "living filter" operation, of improving soil structure, and of least-cost disposal. Nitrogen should not be returned to the land in excess of crop use. The amount of manure per acre to contain this amount of nitrogen depends on the animal ration, the ammonia conversion and denitrification before application, the crop type, and the climate. Typical values for swine wastes on various crops in Indiana are tabulated. Salt buildup should also be considered. (Whetstone, Parker and Wells-Texas Tech University)

## 2367-A11, B1, F1

### A COMPARISON OF FIVE HOUSING SYSTEMS FOR FEEDLOT CATTLE

West Central Experiment Station,
Morris, Minnesota
R. E. Smith, H. E. Hanke, L. K. Lindor, R. D. Goodrich, J. C. Meiske, et. al.
1972 Minnesota Cattle Feeders' Report, University of Minnesota, Research Report B-170, p. 2-22. 15 tab.

Descriptors: *Feedlots, *Confinement pens, *Cattle, *Feeding, *Costs, *Performance, Density
Identifiers: *Housing systems, Efficiency, Gains

Because of the interest expressed by feedlot operators, a three year trial in Minnesota was conducted to study the influence of housing systems and the effect of animal density on feedlot performance. In the first year of study (1969-70), 324 Hereford steer calves (average initial weight of 435 lb) were allotted to five housing systems. In the second and third year, 340 calves (average weight of 431 lb. and 424.5 lb. respectively) were allotted to the five systems. The five housing systems were (1) conventional open shed with outside concrete lot, (2) manure pack confinement with manure scrape alley, (3) cold slat confinement, (4) warm slat confinement, and (5) open lot with dirt mound and windbreak fence. Except for the open lot, each facility was divided to provide two animal densities. All cattle were fed a ration composed of high moisture shelled corn, corn silage and supplement. Average daily gains for the 3 years were highest for cattle housed at 25 or 17 sq. ft./head in the warm slat unit (2.56 and 2.52 lb, respectively) followed closely by the cattle housed at 17 sq. ft. in the manure scrape unit (2.49 lb). Cattle in the open lot had the slowest average daily gains (2.21 lb). Feed cost/100 lb. gain for the 3-year summary were $12.88, $12.98, $13.45, $13.55, and $14.17 for cattle housed in the warm slat manure scrap, cold slat, conventional and open lot, respectively. (Cameron-East Central)

## 2368-A11, B2, D3

### FINISHING YEARLINGS IN INSULATED HOUSING EQUIPPED WITH AN OXIDATION DITCH WASTE DISPOSAL SYSTEM: SUMMARY OF TEN TRIALS

J. C. Meiske, R. L. Larson, J. A. Moore, R. O. Hegg and R. D. Goodrich
1972 Minnesota Cattle Feeders' Report, University of Minnesota, Research Report B-171, p. 23-29.

Descriptors: *Feedlots, *Performance
Identifiers: *Oxidation ditch, *Housing, Floors, Carcass characteristics, Open shed, Insulated housing

The effects of four housing systems on feedlot performance and carcass characteristics of finishing yearling steers were summarized from 10 trials involving 527 cattle. The housing systems were: (1) conventional open shed, cattle self-fed outside, (2) insulated confinement with a slotted floor over an oxidation ditch, cattle self-fed, (3) insulated confinement with a slotted floor over an oxidation ditch, cattle fed twice daily, and (4) insulated confinement with a solid concrete unbedded floor, cattle self-fed. Cattle in confinement consumed less feed (P less than .01) and required less feed/100 lb gain (P less than .01) but gained at rates similar to cattle housed in the open shed. Carcasses of cattle fed in confinement have higher conformation scores and tended to have higher fat measures but graded similar to carcasses of cattle housed in the open shed. Economic calculations showed that lower returns per head resulted for all confinement fed cattle except those confined to an unbedded solid concrete floor in a year round feeding operation. (Meiske, et. al.-University of Minnesota)

## 2369-A11, B1, F1

### COMPARISON OF HOUSING SYSTEMS FOR FEEDLOT CATTLE IN NORTHERN CLIMATES

Northwest Experiment Station,
Crookston, Minnesota
H. F. Windels, R. D. Goodrich, and J. C. Meiske
1972 Minnesota Cattle Feeders' Report, University of Minnesota, Research Report B-172, p. 30-38. 8 tab.

Descriptors: *Performance, *Confinement pens, *Minnesota
Identifiers: *Housing, *Cold confinement buildings, Carcass characteristics, Slatted floors

A trial involving 180 herd-mate steer and heifer calves was conducted to: (1) determine the winter practicality of a slatted floor, cold confinement building in northern Minnesota, (2) compare the performance and carcass characteristics of feedlot cattle housed in cold confinement buildings vs. a conventional pole barn, and (3) compare the performance of cattle housed in cold confinement buildings with either a gable or a shed roof. The cattle in the conventional barn gained significantly (P less than .01) faster (2.41 vs. 2.19, 2.14 lb) and required significantly (P less than .05) less feed/100 lb. gain (728 vs. 778, 781 lb) than cattle in the slatted floor cold confinement barns. Daily feed dry matter intakes were 17.5, 17.0, and 16.6 lb for cattle housed in a conventional barn, or confinement barns with either a gable roof or shed roof, respectively. These intake values were significantly (P less than .05) different from each other. Conventional housing and slatted floor cold confinement housing had similar effects on performance and carcass characteristics of steers and heifers. Performance data of cattle in confinement barns were not significantly influenced by the type of roof. Economic returns from cattle were significantly greater (P less than .01) for conventionally housed cattle than those housed in cold confinement slatted floor barns. (Windels, et. al.- University of Minnesota)

## 2370-A11, B1

### COMPARISON OF RATIONS WITH DIFFERENT CONCENTRATE TO ROUGHAGE RATIOS FOR HOLSTEIN STEERS — A SUMMARY

Southern Experiment Station,
Waseca, Minnesota
K. P. Miller, J. C. Meiske, and R. D. Goodrich
1972 Minnesota Cattle Feeders' Report, University of Minnesota, Research Report B-173, p. 39-42, 5 tab.

Descriptors: *Diets, *Performance
Identifiers: *Rations, *Holstein steers, *Roughages, Corn silage, Hay

Trials which involved 260 head of Holstein steers fed rations with various concentrate to roughage ratios were summarized. Corn silage was used as a roughage source in all seven of the treatments which were compared. Steers fed rations which contained 28.7 or 55.4 percent corn silage dry matter (up to 750 lb) and 16.6 or 28.7 percent corn silage dry matter (from 750 lb to market) had faster rates of gain, were more efficient and produced higher grading carcasses than steers fed other rations containing corn silage. They also required fewer days of feeding and had higher returns. When hay was used as the roughage in the finishing rations in place of corn silage, the cattle consumed less feed, gained slower and required more feed dry matter per 100 lb gain. Steers fed rations with 86.2 percent corn silage dry matter had the slowest and least efficient gains, the lowest grades, the longest feeding period and the lowest returns. (Miller, et. al.-University of Minnesota)

## 2371-B1

### MINERAL ANALYSES OF SOME COMMON MINNESOTA FEEDS

R. D. Goodrich, J. C. Meiske and A. El Fattah El Serafy
1972 Minnesota Cattle Feeders' Report, University of Minnesota, Research Report B-174, p. 44-46, 4 tab.

Descriptors: *Feeds, *Minnesota, *Analyses, Phosphorus, Potassium, Calcium, Magnesium, Iron, Zinc, Copper, Molybdenum, Manganese
Identifiers: *Minerals, Corn, Oats, Barley, Soybean meal, Linseed meal, Middlings

Samples of corn, oats, barley, soybean meal, linseed meal and middlings were analyzed for phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn), copper (Cu), molybdenum (Mo) and manganese (Mn) concentration in the dry matter. Average mineral contents and adjusted values, based on the variation among samples, were presented. When the adjusted values are used to estimate mineral contents of a feed, 84 percent of the time feed samples should contain at least that much of the mineral in question. If average values are used, half of the time the feed would contain less than that amount of the mineral in question. If several feeds are used to formulate a ration, the use of average analyses to predict mineral contents of the ration results in a more specific estimate of the average mixed content than if few feeds are used in the ration. However, both rations would contain less than the average amount of mineral half of the time. (Goodrich, et. al.-University of Minnesota)

## 2372-A11, B1

### INFLUENCE OF AN ANTIBIOTIC ON THE PERFORMANCE OF YEARLING HOLSTEIN STEERS

Department of Animal Science,
University of Minnesota
R. D. Goodrich, D. Crawford, and J. C. Meiske
1972 Minnesota Cattle Feeders' Report, University of Minnesota, Research Report B-177, p. 67-71, 5 tab.

Descriptors: *Antibiotics, *Performance
Identifiers: *Holstein yearlings, Chlortetracycline (Aureomycin), Liver abscesses

Thirty-two yearling Holstein steers were fed a ration without chlortetracycline (Aureomycin) and 31 were fed a daily ration that contained 70 mg of chlortetracycline. Cattle fed the antibiotic gained about 3 percent faster (3.13) vs. 3.04 lb/day), required about 5.5 percent less feed/100 lb gain (579 vs. 613 lb) and were more profitable than steers that did not receive antibiotic in their daily ration. Fifty-three percent (17 head) of the cattle that did not receive antibiotic had liver abscesses, while 29 percent (9 head) of those that received the antibiotic had liver abscesses. (Goodrich, et. al.-University of Minnesota)

## 2373-A11, B1, E3

### FEEDING VALUE OF CORN RECLAIMED FROM AN OXIDATION DITCH AND THE INFLUENCE OF ADDING WATER TO RATIONS FOR FINISHING STEERS

Department of Animal Science,
Minnesota University
J. C. Meiske, R. D. Goodrich, R. L. Larson, J. A. Moore, and R. O. Hegg
1972 Minnesota Cattle Feeders' Report, University of Minnesota, Research Report B-180, p. 84-88, 3 tab.

Descriptors: *Corn, *Recycling, *Water
Identifiers: *Rations, *Oxidation ditch, *Finishing steers, Feed value

Holstein steers were used to estimate the feeding value of corn that had passed through the digestive tract of finishing steers and which was reclaimed from an oxidation ditch and ensiled. The influence of adding water to an all-corn ration was also investigated. Cattle fed rations that contained 21 percent reclaimed corn dry matter performed satisfactorily, but those fed rations containing 44 percent reclaimed corn dry matter gained less rapidly. Although both groups consumed more feed per head daily than cattle fed an all-corn diet containing dry corn, both were less efficient. It was calculated that the dry matter of the ensiled, reclaimed corn had feeding values about 40 percent of that of regular corn dry matter. When water was added to regular corn to make a corn mixture of 71 percent dry matter, the cattle consumed about 3.5 percent more feed dry matter daily; when sufficient water was added to regular corn to make a corn mixture of 59.9 percent dry matter, the cattle consumed approximately 3 percent less feed dry matter daily. However, cattle in the treatment groups which had water added to regular dry corn at feeding time required 11.2 to 15.9 percent less dry matter per 100 lb gain than steers fed only dry corn. (Meiske, et. al.-Minnesota University)

## 2374-A11, B1

### INFLUENCE OF SALT LEVELS WITH AND WITHOUT SUPPLEMENTAL POTASSIUM ON THE PERFORMANCE OF STEER CALVES

Department of Animal Science,
Minnesota University
D. W. Crawford, J. C. Meiske, and R. D. Goodrich
1972 Minnesota Cattle Feeders' Report, University of Minnesota, Research Report B-181, p. 89-98, 7 tab.

Descriptors: *Salts, *Potassium, *Performance, *Cattle, *Feeds, Weights, Feedlots
Identifiers: Gains, Carcass characteristics

A trial was conducted to determine the influence of various levels of supplemental salt on steer calves fed a corn silage-corn grain ration and to investigate the influence of supplemental potassium on salt requirements. Fifty-five Hereford steer calves (average initial weight of 446 lb) were randomly assigned to eight pens. Each pen of cattle was then randomly assigned to each of eight treatments ranging from 0.0 g salt plus 0.0 g potassium per head daily to 37.5 g salt plus 10.0 g potassium per head daily. All calves were fed 10 lb of corn silage and 1 lb/head daily of the respective supplement that supplied the appropriate levels of salt and potassium. Average daily gains were 2.34 lb/head for steers fed no supplemental salt and 2.81, 2.73, and 2.88 for steers fed 12.5, 25.0, and 37.5 g of salt per head daily. Steers fed the lowest level of supplemental salt (12.5 g) had adequate rates of gain, feed intakes, feed efficiencies and carcass characteristics. Steers fed supplemental potassium gained faster than steers receiving no supplemental potassium (2.76 vs. 2.62 lb/head daily). The feeding of potassium also increased feed intake, improved feed efficiency, and lowered feed cost per 100 lb of gain. Carcass characteristics were not significantly influenced by the feeding of supplemental potassium. Results suggest the level of salt may be reduced below present recommended level of 36 to 45 g per head daily (0.08 lb to 0.1 lb/head daily). The feeding of potassium carbonate may result in a slight increase in returns to labor and management when cattle are fed high rations. (Cameron-East Central)

## 2375-B2, D2, D3, E2, F1

### MANAGING ANIMAL WASTE DISPOSAL SYSTEMS

E. D. Anderson
Farm Quarterly, Vol. 27, No. 2, p. 56-58, 1972.

Descriptors: *Lagoons, Design, Sprinkler irrigation, Costs
Identifiers: Land disposal

The poor reputation that lagoons have acquired in some areas is often the result of inadequate design, poor location, and/or improper management. They can be effective in Missouri, less so to the north, and more so to the south. Management suggestions include keeping the water level nearly constant, starting the lagoon at the beginning of warm weather, keeping the pH above 6.7 by adding lime or lye, loading continuously or at least daily, allowing two years for the lagoon to stabilize, and pumping out annually. (Whetstone, Parker, and Wells-Texas Tech University)

## 2376-A4, A5, B1, E2, F1, F2

### HOW TO DISPOSE OF MANURE AND STAY OUT OF COURT

E. D. Anderson
Farm Quarterly, Vol. 27, No. 4, p. 52-56, 1972.

Descriptors: *Waste management, *Legal aspects, *Feedlots, *Cattle, *Dairy industry, Costs, Irrigation, United States
Identifiers: *Canada, Swine, Land disposal

All states and Canadian provinces now prohibit discharge to surface or underground waters. Consult the applicable law before starting or enlarging an operation. Note the distances to downwind neighbors. Adequate spreading areas should be owned or held under long-term lease. Suggestions and cost estimates are given for beef, dairy, and swine operations. (Whetstone, Parker, and Wells-Texas Tech University)

## 2377-A8, B3, C1, C2, E2

### BROILER AS A FERTILIZER

L. H. Hileman
Arkansas Farm Research, January-February, 1965, p. 6. 3 fig.

Descriptors: *Fertilizers, Nutrients
Identifiers: *Broiler litter, *Land disposal, Yields, Application rates, Forage response

In 1964 an experiment was established to evaluate the response of fescue to rates of litter application. Broiler litter was broadcast by hand at rates of 0 to 20 tons per acre, in 2-ton increments plus two very high treatments of 25 and 30 tons per acre. The litter contained

23% moisture, 4.4% nitrogen, 2.69% phosphorus, and 1.95% potassium. The 2-, 4-, and 8-ton rates yielded more forage than no treatment. However, the 4-ton per acre rate significantly increased yields. Yields from the 10- and 12-ton rates were similar to the no treatment. The 25- and 30-ton rates eliminated almost all plant growth. Observations indicated that continued applications of rates exceeding 4 tons per acre may tend to increase the intensity of the yield-depressing effect of high rates of broiler litter. (Cameron-East Central)

### 2378-A4,A5,A8,B3,C1,C2,D1,D2,D3,E2,E3

### MANAGEMENT AND UTILIZATION OF POULTRY WASTES

J. R. Howes
Feedstuffs, Vol. 40, No. 50, p. 22-23, December 14, 1968. 3 fig.

Descriptors: *Litter, *Waste treatment, *Waste disposal, *Chemical properties
Identifiers: *Poultry wastes, *Cage manure

This discussion deals with the disposal or reuse of poultry litter and cage manure. Content of poultry litter and of cage manure is variable. Poultry litter usually contains about 20-25 percent moisture and 2 percent each of nitrogen $P_2O_3$ and $K_2O$. Cage manure contains approximately 75 percent moisture and much less nitrogen, $P_2O_3$ and $K_2O$ because of the dilution. Present day methods of efficiently disposing of poultry wastes include landfill, spreading it as fertilizer, composting, drying, or feeding to poultry and livestock. The advantages of each of these methods are discussed. It is pointed out that recent studies indicate that organic fertilizers are capable of controlling soil nematodes which have not been economically controlled to date in citrus, peach, grass and many other crops. Also, organic manures contain stabilized nitrogen and phosphorus, which, if these products are not over-applied to the land, will not leach out polluting soil water, giving rise to nitrate poisoning, stream and lake eutrophication. (Merryman-East Central)

### 2379-A6, B2, C1, C2, D3

### OXYGEN TRANSFER RELATIONSHIPS IN A POULTRY WASTE MIXED LIQUOR

D. R. Baker
MS Thesis, Cornell University, Ithaca, New York, August, 1973, 132 p. 27 fig, 5 tab, 55 ref.

Descriptors: *Waste treatment, *Poultry, *Aeration, Temperature, Viscosity
Identifiers: *Oxidation ditch, *Oxygen transfer, Solids

Liquid aerobic treatment systems have been found to be effective devices for handling and controlling odors in animal wastes. The purpose of this study was to examine oxygen transfer and uptake relationships of wastewaters at solids concentrations similar to those found in actual waste treatment systems. All of the results and conclusions apply to an aerated mixed liquor in an oxidation ditch which has reached a steady state equilibrium condition. The study showed that oxygen uptake rates were not affected either by temperatures or solid concentrations normally encountered in an in-house oxidation ditch. The results indicated that viscosity measurements can be related to oxygen transfer values. Although the rotor's oxygen transfer rates were not affected by the range of temperatures encountered, increases in solids concentrations did decrease the capability of the rotor to transfer oxygen. (Kehl-East Central)

### 2380-A4,A6,B2,B3,D1,D3,E2

### BIOLOGICAL TREATMENT OF POULTRY MANURE COLLECTED FROM CAGED LAYING HENS

Department of Microbiology,
Guelph University, Guelph, Ontario, Canada
R. G. Bell
Compost Science, Vol. 10, No. 3, p. 18-21, Autumn, 1969, 4 fig, 4 tab, 7 ref.

Descriptors: *Waste treatment, *Biological treatment, *Poultry, Odor, Water pollution, Anaerobic digestion, Flocculation
Identifiers: *Caged laying hens, *Composting, Settling, Extended aeration, Settled solids

As a consequence of the increasing urbanization of agricultural areas, animal production units are becoming surrounded by residential property. Because of the intolerance of the new neighbors and the pollution authorities for obnoxious odors or the pollution of surface waters, better farm management is essential. This is the major reason for the great need for the development of treatment processes by which animal wastes can be converted into valuable soil amendments which lack such objectionable properties. The objective of this study was to attempt to produce a soil amendment which could be applied without creating an odor nuisance or a surface water pollution hazard, from poultry manure collected from both liquid and solid manure management systems. This study was limited to the treatment of the wastes produced by caged laying hens. Several methods were used to attempt to produce stable nonodorous products from poultry manure collected from a liquid manure handling systems. They were: flocculation, anaerobic digestion, settling, extended aeration and composting. All the treatments proved unsatisfactory except composting, which was restricted to the coarsest fraction of the settled solids. The success of composting fresh poultry manure in association with ground corn cob, another agricultural waste, has led to the construction of a pilot scale composting plant. The effects of aeration and the addition of old compost on composting are given. (Kehl-East Central)

### 2381-A4, A5, A8, C2, E2

### COMPARISON OF INORGANIC NITROGEN CONTENTS OF UNDISTURBED, CULTIVATED, AND BARNYARD SOIL PROFILES IN WISCONSIN

Department of Soils and Agricultural Engineering
Wisconsin University, Madison
R. J. Olsen, R. F. Hensler, O. J. Attoe, and S. A. Witzel
Soil Science Society of America Proceedings, Vol. 34, No. 4, p. 699-700, July-August, 1970. 1 tab, 9 ref.

Descriptors: *Nitrates, *Nitrites, *Soil profiles, *Wisconsin, *Water pollution, *Soils
Identifiers: Exchangeable ammonium

The need for adequate disposal of increasing amounts of livestock wastes suggests that pollution of subsurface and surface waters from this source is likely to become of greater importance. The purpose of this study was to obtain information on the contents of nitrate and other forms of inorganic nitrogen in soil profiles under various conditions in Wisconsin, particularly from cultivated fields, undisturbed or virgin locations, and from barnyards. The average total content of $NO_3$-N in the profile was lowest for the undisturbed soils and highest for the cultivated soils. The values for $NO_2$-N were much lower. They were lowest in the well-drained barnyard profiles and highest in the poorly-drained ones. The values for exchangeable $NH_4$-N varied more widely between profiles, were lowest for the cultivated soils and highest for the poorly-drained barnyard soils. The concentration of $NO_3$-N tended to decrease with soil depth, apparently because of denitrification, microbial immobilization processes and plant uptake. The total content to the 240-cm depth of $NO_2$-N ranged from 6 to 25 kg/ha. The results suggest that contamination of the groundwater with $NO_3$-N from animal wastes would mainly concern farm families that consume water from wells located too close to barnyards and feedlots. Excessive rates of applying fertilizer N should be avoided. (Kehl-East Central)

### 2382-A2,A3,A5,A6,B2,B3,D3,E2

### ANIMAL WASTE MANAGEMENT WITH POLLUTION CONTROL

J. R. Miner and W. E. Verley
Oregon State University, NC-93 Annual Report, October 1974 27 p. 9 fig, 12 tab, 6 ref.

Descriptors: *Lagoons, *Economics, *Odor, *Ohio, Soils, Agricultural runoff
Identifiers: *Pollution control, *Animal waste management, *Swine, *Composting, *Land disposal, Application rates, Groundwater quality

The Agricultural Engineering Department continued to evaluate handling swine waste with flushing and a two stage lagoon system. Experimental objectives were: to determine the treatment efficiency of the system, measure the nitrogen losses in each unit, determine whether ground water pollution occurs from the lagoons, and to evaluate the system with respect to equipment system effectiveness, and economics. In another experiment, a built-up bed, aerobic composter was designed to provide both treatment and storage capability. Evaluations of rate of application, type and condition of manure, temperatures achieved within the composting mass and resultant compost quality and condition are in progress. Other projects underway include modeling livestock waste systems and studies of malodorous substances and their abatement. The Agronomy Department has installed field lysimeters to determine the maximum rate of cattle manure that can be applied to various Ohio soil types without adversely affecting groundwater quality. Cooperative research has been initiated through a Memorandum of Understanding between the Ohio Agricultural Research and Development Center and the USDA-ARS-North Appalachian Experiment Watershed, Coshocton, Ohio. Numerous watersheds are available to study runoff from pastures and feedlots. Cow herds will be managed under 3 systems: (1) limited stocking rate and fertilizer application with grazing during the growing season only; (2) high stocking rate and fertilizer application with year-long grazing and; (3) moderate fertility and stocking rate with hay fed on pasture during winter. Cattle will be fed in drylot with varying proportions of concentrates and roughages. Runoff, ground water and soil sediments will be analyzed for N, P, K, BOD, etc. where applicable. (Ohio Agricultural Research and Development Center; abstract edited by L. Merryman)

### 2383-A4,A6,A13,B1,C2,C3,F1,F2,F3

### ECONOMIC ASPECTS OF FEEDLOT WASTE POLLUTION

Department of Agricultural Economics
M. Baker
Proceedings, Pollution Research Symposium, Lincoln, Nebraska, May 23, 1969, p. 46-49, 4 ref.

Descriptors: *Economics, *Feedlots, *Farm wastes, *Standards, Odor, Fish kills, Agricultural runoff, Aesthetics, Water pollution
Identifiers: *Pollution control

Feedlot waste pollution control is looked at from an economist's point of view. It is recognized that feedlots may ultimately pollute water with bacteria and high nitrate levels, that they may be the source of unpleasant odors, that they may be the cause of fish kills, and that they may be aesthetically offensive. It is also recognized that pollution control standards must be met. But how and to what extent? The cost of this pollution control will probably be borne by the cattle industry. Most of the cost will probably be borne by the producer of feeder cattle. This could cause shift of production area, elimination of smaller feedlots, and added competition from animal substitute products such as synthetic meats. The impact of meeting pollution control standards is a matter of speculation. Continued research is needed in order to determine what pollution control standards should be met and how they should be met. (Battles-East Central)

### 2384-B2, C3, D3, F6

### SURVIVAL OF PATHOGENS IN ANIMAL MANURE DISPOSAL

Minnesota University, St. Paul
S. L. Diesch, B. S. Pomeroy, and E. R. Allred
Environmental Protection Agency Report No. EPA 670 2 73 051, Minnesota University, St. Paul, August 1973. 135 p.

Descriptors: *Pathogenic bacteria, *Waste disposal, *Model studies, Slurries, Sludge, Temperature, Cattle, Minnesota
Identifiers: *Oxidation ditch, *Survival, *Leptospira pomona, *Salmonella typhimurium, pH

A laboratory model (1:10 scale) of an operational field oxidation ditch used in beef cattle production was utilized in survival and detection studies of Leptospira pomona and Salmonella typhimurium. Minnesota summer (20C) and winter (2C) temperatures, pH, and dissolved oxygen of field ditch manure slurry were simulated in laboratory model studies of manure slurry, effluent, and sludge. Maximum leptospiral survival times of 138 days (summer) and 18 days (winter) in the slurry were measured. Salmonella survival of 47 days in slurry and 87 days in sludge (winter), and 17 days in slurry (summer) were measured. Adequate laboratory cultural detection and isolation techniques were developed to measure survival. Findings from simulated studies in a second laboratory model were used to separate materials for recycling. (Diesch et. al.-Minnesota University)

### 2385-A3, A8, B2, E2

### PHYSICAL PROPERTIES OF A COLO SILTY CLAY LOAM SOIL DURING TWO YEARS' IRRIGATION WITH EFFLUENT FROM BEEF FEEDLOTS AND WATER FROM A CREEK

D. H. Hinrichs
Unpublished M. S. Thesis, University of Nebraska, Lincoln, 1973, 74 p. 10 tab, 18 append., 51 ref.

Descriptors: *Physical properties, *Irrigation, *Effluent, *Feedlots, *Nebraska, *Water, Cattle, Rainfall, Agricultural runoff, Management, Waste disposal, Moisture
Identifiers: *Colo silty clay loam

A study was done to obtain information on the influence of effluent applications on soil physical properties and to recommend management practices. The field site was located on the flat area between the footslopes and a nearby creek. There were 15 plots consisting of five treatments replicated three times. The following tests for physical properties of soil were conducted on the soil samples: particle size analysis, bulk density, moisture release, water stability of aggregates, hydraulic conductivity, and rainfall splash. Results showed the soil for the plot area to be a Colo silty clay loam with 2.1% sand, 68.1% silt, and 28.6% clay. There were significant differences in bulk density for treatments and dates of sampling. No obvious differences in moisture release curves were noted from the application of effluent. Geometric mean diameters of water stable aggregates were not influenced by the irrigation. Leaching occurred during the 1971-72 season of irrigation when 54 cm of rainfall was recorded for the period of October through May. (Cameron-East Central)

### 2386-A2,A4,A6,A8,B2,B3,D2, D3,E2,E3

### ANIMAL WASTE MANAGEMENT IN TEXAS: TESTIMONY PRESENTED TO THE SOLID WASTE STUDY COMMITTEE OF THE TEXAS HOUSE OF REPRESENTATIVES

Texas Agricultural Extension Service,
Texas A&M University, College Station
J. M. Sweeten
Memo AENG 6, Texas Agricultural Extension Service, Texas A&M University, College Station, Texas, 1972, 10 p.

Descriptors: *Animal wastes, *Texas, *Feedlots, *Cattle, Proteins, Recycling, Poultry, Water pollution, Dehydration, Fertilizers, Odor
Identifiers: *Waste, Land disposal, Application rates, Building materials, Refeeding, Pyrolysis, Turkeys

Beef feedlots account for 65 percent of the animal manure (dry weight basis) in Texas. Of the total tonnage, 70 percent is from lots which do not contribute to surface runoff under storms of less than once-in-25-years frequency. Other lots are being upgraded toward this goal. Land disposal provides fertilizer and soil conditioning benefits. No salt build-up occurs with application rates below 300-900 tons/acre. "To summarize, land disposal of solid beef feedlot wastes at rates consistent with sound agronomic practice gives benefit-cost ratios of about 2:1 or 3:1." Other methods cited are conversion to a protein source by thermophilic bacteria (GE-Casa Grande, Arizona), conversion to building materials by mixing with glass and heating at atmospheric pressure to 300-400 degrees C and 3000-4000 psi, refeeding as a fermented mixture of manure and hay, and pyrolysis with ammonia recovery. Turkey feedlots contribute to water pollution. It is usual in Texas to move the pens rather than the manure, utilizing the fertilizer value of the manure where it falls. Caged layers produce a high-nitrogen waste. Dehydration and refeeding appear promising. Sweeten urges a cautious approach to this solution. Broiler manure has value as a fertilizer and in cattle feed rations. For dairy cattle and swine, liquid manure handling is usual. Odor problems arise. Lagooning provides little economic return. Slurry irrigation by pipeline and spray nozzle or by storage pit and honey wagon is recommended. (Whetstone, Parker, & Wells-Texas Tech University)

### 2387-B2, D3, E2

### BIOLOGICAL TREATMENT OF BEEF ANIMAL WASTES

Water Resources Research Institute,
Kansas State University, Manhattan
L. A. Schmid and R. I. Lipper
Completion Report No. 77, Water Resources Research Institute, Kansas State University, Manhattan, June 1971, 50 p. 17 fig, 12 tab.

Descriptors: *Anaerobic digestion, *Waste treatment, Irrigation
Identifiers: *Oxidation ditch, *Land disposal, *Loading rates, Liquification

An anaerobic digestion system and an oxidation ditch system were employed in this study to investigate the treatment, handling, and disposal of the confined beef animal wastes. Considering only acid fermentation, the process permits the use of the anaerobic digester under little skilled supervision for manure liquification. Uncontrolled field environmental factors, such as low temperatures, low pH, and intermittent and shock loading do not inhibit the acid forming bacterial activities which are responsible for liquifying the organic solids. The liquified manure is more readily degradable for further treatment, can be returned to the soil for agricultural irrigation, and has less pollutional strength for disposal on land. The anaerobic digestion system for solids liquification can be one answer to handling, holding, and disposing of the confined beef animal wastes. The oxidation ditch system, with a loading of one animal per 60 cu. ft. of liquid volume, provides a potential treatment of beef animal wastes. The two rotors in this system, with a speed of 200 r.p.m. and an immersion depth of 3 inches, are capable of maintaining adequate waste velocity and oxygenation. (McKenna-Kansas Water Resources Research Institute)

### 2388-A8, B2, D3

### SOIL MODIFICATION FOR DENITRIFICATION AND PHOSPHATE REDUCTION OF FEEDLOT WASTE

Department of Crop and Soil Sciences,
Michigan State University, East Lansing
A. E. Erickson, B. G. Ellis, J. M. Tiedje, C. M. Hansen, and F. R. Peabody
Environmental Protection Agency, Technology Series Report EPA-660/2-74-057, June 1974, 118 p. 9 fig, 24 tab, 10 ref.

Descriptors: *Denitrification, *Aerobic treatment, *Soil treatment, *Farm wastes, *Phosphates, *Waste water treatment, Hogs, Dairy industry, Anaerobic conditions, Waste treatment, Feedlots, Biodegradation, Pilot plants
Identifiers: Barriered landscape water renovation systems, Organic matter decomposition, Phosphate fixation

The efficiency of pilot-size Barriered Landscape Water Renovation Systems (BLWRS) to renovate flushed livestock waste was studied. The BLWRS is a modified permeable soil that has an aerobic zone for the filtering and oxidation of the waste and an anaerobic zone to which an energy source is added to create an environment for denitrification. Two pairs of BLWRS 0.008 ha. in size were constructed using a polyvinyl barrier to create the anaerobic zone and contain the effluent. Flush wastes from swine or dairy cattle were applied on each pair of BLWRS. The waste effluents and BLWRS soil were periodically analyzed for nutrients, oxygen demand and pathogens. At manure loading rates of up to 122 t/ha. swine waste and 93 t/ha. of dairy waste, the BLWRS had an efficiency of 80 percent and 97 percent for nitrogen renovation, greater than 99 percent for phosphate and 93 percent for carbon. The oxygen demand dropped 50- to 100-fold. Under normal operating conditions, the pathogenic indicator organisms did not appear in the effluent. The BLWRS has been shown to be an efficient system for renovating large quantities of livestock waste and should be tested on a commercial scale with continuous monitoring. (EPA) (Selected Water Resources Abstracts)

### 2389-B3, D3, E2

### INDUSTRIAL AND AGRICULTURAL SOLID WASTE AND PROBLEMS INVOLVED IN THEIR DISPOSAL

Chief, Basic Data Branch, Division of Technical Operations, Bureau of Solid Waste Management, Environmental Control Administration, Consumer Protection and Environmental Health Service, Cincinnati, Ohio
T. J. Sorg
Public Health News, Vol. 51, No. 3, p. 67-69, March 1970. 2 ref.

Descriptors: *Industrial wastes, *Solid wastes, *Agricultural wastes, *Waste treatment, Waste disposal, Recycling

The solid waste generated from an industrial plant may be classified into five categories based on source: 1. cafeteria waste; 2. packaging and shipping waste; 3. office waste; 4. general plant operation waste; 5. processing waste specific to the industrial plant. To determine the state of the art of industrial waste management practices, the Bureau of Solid Waste Management is conducting a number of studies and surveys on various industries on a national basis. An area being explored that will play a significant role in waste management is the utilization or reprocessing of industrial solid waste. Agricultural solid waste problems differ from industrial solid waste problems. The physical and chemical composition of the agricultural solid waste is not as varied as industrial solid waste. Agricultural wastes are primarily animal manure and bedding; dead animals; and the leaves, stalks, stubble, and culls from agricultural crops. The amount of agricultural waste produced annually exceeds the solid waste production from any other segment of the economy. The traditional disposal method for manures has been to spread them on land, but this method is often impractical. Further research must be done. Two waste management alternatives being demonstrated by the Bureau of Solid Waste Management are utilization of lagoon treatment processes for dairy manure and long-distance pipeline transport of sludge for disposal on land. (Cartmell-East Central)

## 2390-A2, B5, C2

### CATTLE FEEDLOT WASTEWATER SALINITY

Tsao, Ter-Fung
MS Thesis, Department of Civil Engineering, Colorado State University, March 1972, 80 p. 15 fig, 19 tab, 44 ref.

Descriptors: *Feedlots, *Cattle, *Waste water (pollution), *Salinity, *Agricultural runoff, *Feeds, Nutrients, Sampling, Chemical analyses

In this study, cattle manure samples from different feedlots with different salt concentrations in the feed were analyzed to determine how the salt concentration in the feed affects the salinity of the manure solution. Fresh manure samples from different pens of both university feedlots and commercial feedlots were collected for laboratory analysis. It was found that the more salt cattle feed contains, the higher is the specific conductance of the manure solution and the greater is the dissolved volatile and non-volatile solids content in the fresh manure. The logarithm of the sodium-absorption-ratio of the one percent manure solution is proportional to the specific conductance of the solution. These facts demonstrate that the salt in cattle feed increases the water salinity problem of cattle feedlot runoff. (Cartmell-East Central)

## 2391-A9, B2, B3, D1, D2, E2, E3

### A REPORT FROM PENNSYLVANIA STATE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

Department of Animal Science,
Pennsylvania University
L. L. Wilson, T. A. Long, H. D. Bartlett, G. O. Bressler
Presented at Conference on Agricultural and Processing Wastes in the Eastern Region: A Perspective, Philadelphia, Pennsylvania, December 1-3, 1970, p. 35-43. 14 ref.

Descriptors: *Recycling, Livestock, Insecticides, Fertilizers, Feeds, Sawdust
Identifiers: *Refeeding, Horticultural wastes, Dried poultry wastes, Waste paper, Garbage

The projected increase in the world's population within the next few decades emphasizes the need for conserving existing resources and for utilizing them efficiently. This means that wastes resulting from agricultural production and processing need to be recycled. Among options for the agricultural producer are the following. Horticultural wastes could be fed to ruminants. However the feeding of apple wastes in the early 1960's resulted in approximately 76 p.p.m. of DDT being deposited in fat tissues of the waste-fed cattle; consequently, use of pesticides must be taken into consideration. Treated poultry waste rations may be used as a feed for ruminants. Liquid manure may be disposed of on grasslands. Sawdust may be used as a substitute roughage for cattle. Waste paper may be used in the ruminant diet. Paper manufacturing wastes may be fed to ruminants. Dried poultry manures may be used as fertilizers, mulches and animal feeds. Milk-house liquid wastes may be distributed to the land through a sprinkler irrigation system. Dried cottage cheese whey is a potential powdered milk substitute. The suitability of digested soft urban garbage is under study for its suitability as a fertilizer or as a feed source for ruminant animals. These are all recycling possibilities that have been the subject of past or present study. (Merryman-East Central)

## 2392-A2, A4, A6, B1

### A PERSPECTIVE FOR CONNECTICUT

Connecticut University
J. J. Kolega
Presented at Conference on Agricultural and Processing Wastes in the Eastern Region: A Perspective, Philadelphia, Pennsylvania, December 1-3, 1970, p. 44-48.

Descriptors: *Connecticut, *Poultry, *Dairy industry, Agricultural runoff, Odor, Water pollution, Septic tanks, Research and development
Identifiers: *Waste management, Horses

Agricultural waste problems in Connecticut are primarily those associated with the poultry and dairy industry. Prime problems for the dairy industry are surface runoff from paved areas; surface discharges into streams or into a drinking water supply watershed, and milking center discharges. The poultry producer's problems are even more serious due to the small amount of land accomodating his operations and due to the corresponding population growth around these operations. The major complaints against the poultry producer have been directed toward the odors emanating from his facilities. Another problem requiring attention in Connecticut is the handling of septic tank pumpings. About two-thirds of Connecticut's geographic area is estimated to be using septic-tank disposal systems or their equivalent. University of Connecticut studies related to these three problem areas are listed with corresponding addresses. A relatively new problem area developing in Connecticut is related to the influx of pleasure horses. A general recommendation for the handling of the wastes from these animals has not yet been developed. (Merryman-East Central)

## 2393-A4, A8, E2

### PLANT NUTRIENT BUDGETS AND WASTE DISPOSAL

Connecticut Agricultural Experiment Station
C. R. Frink
Presented at Conference on Agricultural and Processing Wastes in the Eastern Region: A Perspective, Philadelphia, Pennsylvania, December 1-3, 1970, p. 49-52. 1 tab. 5 ref.

Descriptors: *Nutrients, *Waste disposal, *Nitrogen, *Phosphorus, *Connecticut, *Eutrophication, Fertilizers, Dairy industry
Identifiers: *Land disposal

One of the most pressing environmental concerns in Connecticut is the enrichment of lakes and streams with plant nutrients that encourage the growth of weeds and algae. The nutrients responsible for these problems may come from fertilizers, animal and human waste disposal, or erosion from a new housing development. The largest single source of plant nutrients in Connecticut, excluding human waste, is dairy farming. Efficiency of nutrient conversion by land used in waste disposal decreases as farm size decreases. Every effort should be made in the Northeast to keep land available so that crops may utilize the applied nutrients more efficiently. Agronomic approaches reducing nitrogen losses include application of fertilizer and manure to growing crops rather than to bare or frozen soil, selection of crops with both high yield and high protein content, increased plant populations, and more extensive use of cover crops. (Merryman-East Central)

## 2394-A4, A5, A6, B1, D2, D3, E2, E3, F4

### ANIMAL WASTE MANAGEMENT IN MODERN PRODUCTION SYSTEMS

Department of Poultry Science,
Cornell University, Ithaca, New York
R. J. Young
Presented at Conference on Agricultural and Processing Wastes in the Eastern Region: A Perspective, Philadelphia, Pennsylvania, December 1-3, 1970, p. 53-60. 6 ref.

Descriptors: *Waste disposal, *Research and development, *Waste treatment, Odor, Water pollution, Nutrients, Fertilizers, Dehydration, Incineration
Identifiers: *Waste management, *Land disposal, Oxidation ditch

The design of animal production units of the future must take into consideration the conditions necessary for optimum production with a management system that will minimize environmental pollution. The encroachment of resort and residential developments into rural areas increases this necessity. It is essential that the cost of livestock operation include waste handling and disposal costs. In the College of Agriculture at Cornell University, an Interdepartmental Task Force has been developed with representatives from the Departments of Agricultural Economics, Agricultural Engineering, Agronomy, Animal Science, Food Science, and Poultry Science to investigate such management problems as waste disposal systems, odor identification and control, water pollution prevention, nutrient removal, reutilization of animal wastes as fertilizers or foodstuffs, and new methods of waste management which can economically become part of the total production system. Studies discussed include: (1) use of an oxidation ditch in a poultry house, (2) incineration of poultry manure, (3) dehydration of poultry manure with heated air, and (4) water pollution from land disposal of manure. (Merryman-East Central)

## 2395-A5,A8,B2,C2,D3,E2

### TREATMENT AND DISPOSAL OF ANIMAL WASTES IN MASSACHUSETTS

Massachusetts University
J. T. Clayton
Presented at Conference on Agricultural and Processing Wastes in the Eastern Region: A Perspective, Philadelphia, Pennsylvania, December 1-3, 1970, p. 61-67.

Descriptors: *Massachusetts, *Waste treatment, *Waste disposal, *Research and development, *Animal wastes, Aeration, Effluents, Nitrogen, Groundwater pollution, Lagoons, Ponds
Identifiers: Land disposal

In an attempt to provide usable engineering design information, studies of several components of treatment systems are being conducted. Under study are the following (1) An extended aeration system of manure mixed with water to form a slurry. (2) The effects of disposal of effluent from the above mentioned system at a subsurface level in terms of chemical, microbiological, and physical properties of constructed profiles, as well as the degree of tertiary treatment in the soil. (3) Distribution of animal waste effluents within the soil with an orifice or nozzle that can reliably effect uniform discharge. (4) Flow of nitrogen through the soil with the purpose of establishing what effect adsorption of nitrogen by soil particles would have on nitrogen contamination of groundwater in the vicinity of waste stabilization ponds. (5) The effects of groundwater on the movement of nitrogen in soils adjacent to lagoons or ponds. (Merryman-East Central)

## 2396-A4,A5,A7,A8,A12,B1,F2

### AN ASSESSMENT OF THE AGRICULTURAL AND PROCESSING WASTE PROBLEMS AND CONTROL IN WEST VIRGINIA

West Virginia Agricultural Experiment Station
A. D. Longhouse
Presented at Conference on Agricultural and Processing Wastes in the Eastern Region: A Perspective, Philadelphia, Pennsylvania, December 1-3, 1970, p. 68-73. 1 tab.

Descriptors: *Regulation, *West Virginia, *Agriculture, *Water pollution, *Air pollution, Soil contamination, Health

Pollution of air, water, and soil from agricultural sources is not yet a serious problem in West Virginia, but it is growing. Legislative acts delegating authority for the control of all sources and types of pollutants, including those of agriculture, are vested in several state agencies. The three regulatory agencies of West Virginia which are responsible for enforcing pollution laws are: the State Board of Health, the Department of Natural Resources, and the Air Pollution Control Commission. The State Board of Health supervises and controls the Department of Health and makes and enforces health regulations. This regulation includes dairies, creameries, and slaughterhouses. The Department of Natural Resources administers the Water Pollution Control Act and the Surface Mining Act. The Air Pollution Control Commission administers the Air Pollution Law of West Virginia. In practice, no single regulatory body has sole jurisdiction and responsibility regarding pollution. Each agency's involvement corresponds with its areas of interest. (Merryman-East Central)

## 2397-B2,B3,D2,D3,E2,E3,F5

### A REVIEW OF METHODS FOR RECYCLING ANIMAL MANURES

Kentucky University
I. J. Ross
Presented at Conference on Agricultural and Processing Wastes in the Eastern Region: A Perspective, Philadelphia, Pennsylvania, December 1-3, 1970, p. 74-77, 1 fig, 8 ref.

Descriptors: *Recycling, *Feeds, *Fertilizers, *Algae, *Fish, *Fermentation.
Identifiers: *Manure, *Fly larvae, *Broiler litter, *Refeeding, *Microbes.

Because the agricultural industry has many critical waste management problems, many new practices and concepts are being tested and researched. Recycling of manures is one such concept. Among the recycling measures considered in this publication are:
(1) Use of manure as fertilizer for plants.
(2) Production of algae in anerobic waste lagoons as a potenitial feedstuff.
(3) Feeding fish diets containing animal manure.
(4) Biodegradation of manure by fly larvae. The end product may then be used as a soil conditioner and a feed supplement.
(5) Use of broiler litter in rations for ruminants.
(6) Fermentation of fresh poultry manure with Rumen microbes to produce high protein feeds. (Merryman-East Central)

## 2398-A6,B2,B3,D3,E1,F1

### ROLE OF AGRICULTURE IN THE QUALITY OF THE NEW HAMPSHIRE ENVIRONMENT

Institute of Natural and Environmental Resources
New Hamrshire University.
R. D. Harter.
Presented at Conference on Agricultural and Processing Wastes in the Eastern Region: A Perspective, Philadelphia, Pennsylvania, December 1-3, 1970, p. 78-83. 2 tab.

Descriptors: *Agriculture, *Environment, *New Hampshire, *Cattle, *Waste disposal, Lagoons, Swine, Poultry, Water pollution, Odor.
Identifiers: *Animal wastes, Oxidation ponds.

The majority of New Hampshire's land area is too hilly to support an economically viable agricultural operation. A large portion of the remaining area is too wet to farm. Fruit and vegetable farming has been of minor importance. But the steady increase in tourism is encouraging roadside vegetable stands. New Hampshire has a minor animal industry when compared to many states. Sheep are largely confined to the hillier, less populated regions of the state. Hog production is scattered across the state, a few hogs to a farm. Poultry production is nearer populated areas and is often accompanied by odor problems. Waste produced by cattle is roughly equivalent to that produced by the entire human population of the state. Mass waste disposal systems are uneconomical because few dairy herds exceed 100 head, and the majority are less than 30 head. Although oxidation ponds are more acceptable than lagoons, the structure still has generally not been acceptable as a waste disposal method. The New Hampshire Cooperative Extension Service personnel are meeting with farmers and are educating them to the role they must undertake. This service has been the most important single factor in the control of pollution from agricultural sources. (Cameron-East Central).

## 2399-B1, B3, D3, E1, E2

### REPORT FROM NEW JERSEY

College of Agriculture and Environmental Science
Rutgers University.
H. E. Besley.
Presented at Conference on Agricultural and Processing Wastes in the Eastern Region: A Perspective, Philadelphia, Pennsylvania, December 1-3, 1970, p. 84-85.

Descriptors: *New Jersey, *Environmental control, *Waste disposal.
Identifiers: *Pollution control.

Many qualified observers feel New Jersey to be our most urbanized state and they feel that New Jersey has some of the most stringent environmental quality control laws in all the world. As a reflection of New Jersey's concern for the environment, Rutgers University is exerting major research and education in the area of environmental quality. Present and recently completed projects include:
(1) An inventory in four New Jersey counties of the quantity of animal wastes and of the types of disposal methods utilized.
(2) The development of equipment and procedures for disposing of solid and semi-solid organic wastes in the soil.
(3) Utilization of rapid composting as a means of stabilizing the wastes resulting from feeding garbage to hogs.
(4) Utilization of organic wastes and silt dredged from streams and waterways to reclaim and increase productivity of abandoned or under utilized lands such as former gravel pits, areas of the pine barrens, etc.
(5) Development of incinerable plastic bottles and utilization of food packages and containers which are more readily disposable than those currently in use.
(6) Research concerning plant responses to air contaminants, such as stack and engine exhaust gases.
(7) Treatment of domestic and industrial wastes to reduce pollution potential. (Merryman-East Central).

## 2400-A11, B5, C3

### RELATION OF VITAMIN B12 TO THE GROWTH FACTOR PRESENT IN COW MANURE

Bureau of Animal Industry, Agricultural Research Administration, United States Department of Agriculture, Beltsville, Maryland.
R. J. Little, C. A. Denton and H. R. Bird.
Journal of Biological Chemistry, Vol. 176, p. 1477-1478, 1948. 1 tab, 2 ref.

Descriptors: *Farm wastes, *Growth rates, *Cattle, *Poultry, Bacteria, Injection, Feeds.
Identifiers: *Vitamin $B_{12}$, *Manure.

Crystalline vitamin B12, reported to have activity for chick growth, has been found to be completely effective, either orally or by intramuscular injection, when tested by laboratory method to assay quantities of the unknown growth factor occurring in cow manure, in fish-meal, and in some other feedstuffs of animal origin. The results show that the maximum growth response was the same in two experiments. One experiment used crystaline B12 and the acid precipitate of water extract of cow manure as a dietary supplement. The other experiment used crystalline B12 and 2 units of liver extract. In view of the potency of this vitamin as a bacterial growth factor, the injection experiments are of particular interest since they show that its effect on the chick is direct and not mediated through the intestinal flora. (Cartmell-East Central).

## 2401-B3, C1, F6

### DRYING CHARACTERISTICS OF FULLY EXPOSED FORMED POULTRY EXCRETA

T. M. Midden.
M. S. Thesis, University of Kentucky, Lexington, January, 1972, 69 p., 17 fig.

Descriptors: *Poultry, *Equations, Temperature.
Identifiers: *Excreta, *Drying characteristics, Diameter.

The experiments described in this thesis were designed to determine some of the basic drying characteristics of poultry manures. The specific objectives were: 1. To determine the material constants for and evaluate the usefulness of several drying models for predicting the drying characteristics of formed poultry excreta. 2. To determine the effects of drying air temperature and formed cylinder diameter on the material constants for the most useful model. 3. To determine the time-temperature relationship to form a stable crust on a cylinder of manure. The following thin-layer drying equation was used to describe the fully exposed drying characteristics of formed poultry excreta—$MR=e-kt$. The effect of drying air temperature on the value of the thin layer drying constant for a particular diameter cylinder can be explained by an Arrhenius type equation—$\ln k= \ln a=-b/R$. The effect of cylinder diameter on the value of the thin-layer drying constant for a particular temperature is explained by the exponential equation $\ln k=\ln a+bd$. A crust can be formed on the surface of a cylinder of poultry manure when the cylinder is exposed to high temperature drying air. The time required to form a stable cylinder increases with increasing cylinder diameter and decreases with increasing temperature. (Cartmell-East Central).

## 2402-B5, C2, D3

### BIODEGRADATION OF THE PIG WASTE: BREAKDOWN OF SOLUBLE NITROGEN COMPOUNDS AND THE EFFECT OF COPPER

School of Agriculture, Aberdeen, Scotland, Great Britain.
K. Robinson, S. R. Draper and A. L. Gelman.
Environmental Pollution, Vol. 2, p. 49-56, 1971. 2 fig., 4 tab, 8 ref.

Descriptors: *Waste treatment, *Biodegragation, *Copper, *Nitrogen compounds, Slurries, Rations, Chemical oxygen demand, Aeration.
Identifiers: *Swine.

The presence of large amounts of copper salts in many commercial pit-feed supplements represents a potential difficulty in the treatment of pig waste slurries. In view of the fact that copper is known to inhibit the growth of many aerobic bacteria, it is possible that the aerobic breakdown of pit waste might be inhibited if high levels of copper are excreted in the faeces. This was evaluated by examining both the amount of copper excreted and the effect of copper salts on the biodegradation of aliquots of waste, incubated under laboratory conditions. Calculations based on the daily volume of excreta indicated copper concentrations of 750 ppm in the slurry of animals fed on copper supplemental diets. When copper, at different concentrations, was included in pig urine and the liquid aerated, a graded inhibition of the reduction of COD was noted, commencing at 50 ppm and being complete at 500 ppm. (Cartmell-East Central).

## 2403-A6, B2, D2, D3

### TECHNICAL ASPECTS OF LIQUID COMPOSTING

The DeLaval Separator Company, Poughkeepsie, New York.
L. S. Craurer, and B. Hoffman.
Journal of Milk and Food Technology, Vol. 377 No. 6, p. 293-301, June 1974.

Descriptors: *Dairy industry, *Odor, *Biological treatment, *Liquid wastes, Chemical treatment.
Identifiers: *Composting, *Deodorization.

The DeLaval Separator Company has developed a liquid composting system for deodorizing, pasteurizing, biologically decomposing, and chemically purifying dairy cow waste. The theory of liquid composting and several modes of LITCOM (Liquid Composting) System operation are decribed. Particular emphasis is placed on a description of a completely automated manure handling and treatment system operating at an 80-cow, free-stall dairy barn. Data covering 2 years of operation are presented. (Solid Waste Information Retrieval System).

### 2404-B2, C2
### CHEMICAL COMPOSITION OF EFFLUENT FROM HIGH DENSITY CULTURE OF CHANNEL CATFISH

Agricultural Experiment Station, Georgia University, Savannah.
J. W. Page, and J. W. Andrews.
Water, Air, and Soil Pollution, Vol. 3, No. 3, p. 365-369, September, 1974.

Descriptors: *Channel catfish, *Fish farming, *Organic wastes, *Animal metabolism, Fish management, Biochemical oxygen demand, Water quality control, Water pollution sources, Analytical techniques, Nitrogen compounds, Waste water (Pollution), Metabolism.
Identifiers: *Metabolic waste products.

Production rates of metabolic wastes by channel catfish (Ictalarus punctatus) were estimated by analyzing effluents from high density culture of 940 g and 60 g catfish. Results were integrated over a 24 h steady-state period in which normal feeding activities were maintained and were expressed as g/day/kg fish and g/day/kg feed consumed. When expressed on a unit fish weight basis, production rates were greater for 60 g than for 940 catfish. However, when expressed on a feed consumption basis, production rates of most catabolic products were approximately equal for both size fish. Average values (g/day/kg feed) were as follows: total N, 67; ammonia N, 20; nitrate-nitrite N 20; 5-day BOD, 98; total solids, 180; total P, 15; total K, 18. Filtered solids from effluent contained 5% nitrogen, 1.6% phosphorous and .13% potassium. Diurnal variation in production rates were noted with solid production reaching maximum after each feeding and BOD, NH3, and nitrate reaching a maximum only in the afternoon. (Katz).

### 2405-A2, A4, B2, C1, C2, D3, E2
### SOIL ADSORPTION OF HUMIC COLOR

Department of Civil Engineering, Nebraska University, Lincoln.
R. A. Miller.
MS Thesis, Nebraska University, Lincoln, May 1974, 49 p. 10 fig, 5 tab, 22 ref.

Descriptors: *Color, *Feedlots, *Adsorption, *Chemical oxygen demand, *Waste water treatment, Sands, Waste disposal, Biological treatment, Runoff, Water quality, Soils, Design criteria, Farm wastes.
Identifiers: *Soil adsorption beds.

The degradation of receiving streams and lakes has prompted many studies on the treatment of feedlot runoff. Various biological treatment systems have been developed to reduce organic strength levels; however, economic color reduction has not been obtained. The main purpose of this study was to evaluate color reduction of feedlot runoff by the process of soil adsorption. Significant reductions in chemical oxygen demand were also anticipated. Conclusions are as follows: (1) color and COD removal from biologically treated feedlot runoff can be obtained by adsorption on clayey fine sand; (2) reduction of color and COD using soil beds is an effective, economical technique for disposal of biologically treated feedlot runoff; and (3) loading rates of 2 inches per day or less and depths of 5 feet or more should be used as design criteria for soil adsorption beds operating full. (Selected Water Resources Abstracts).

### 2406-A11, B5
### EFFECT OF ANTIBIOTIC SUPPLEMENTATION ON THE DECOMPOSITION OF ANIMAL WASTES

F. K. Elmund.
MS Thesis, Colorado State University, Fort Collins, March 1970, 42 p., 3 fig, 6 tab, 18 ref.

Descriptors: *Antibiotics, *Degradation, Cattle, Feedlots, Microorganisms.
Identifiers: *Manure, *Chlortetracycline, Pollution.

Experiments were conducted to evaluate the possible presence and role of metabolic inhibitors in excreted wastes of cattle which had ingested chlortetracycline. It was felt that alteration of the decomposition process might increase the potential pollution hazards of these excreted wastes. The results of these studies suggest that antibiotic supplementation of animal feeds selects for a microbial population relatively inefficient in the stabilization process. In addition, ingested antibiotic apparently alters the digestive processes in the animal, producing excreted wastes which are less biodegradable. (Cartmell-East Central).

### 2407-A4, A6, A11, A12, B2, B3, C3, D3, E2, F2
### FARM WASTE DISPOSAL

United Kingdom Ministry of Agriculture, Fisheries and Food.
United Kingdom Ministry of Agriculture, Fisheries and Food. Short Term Leaflet 67, Amended 1973, 24 p. 4 tab.

Descriptors: *Waste disposal, *Waste treatment, *Aerobic conditions, Effluent, Anaerobic digestion, Livestock, Legal aspects, Pathogenic bacteria, Irrigation.
Identifiers: *United Kingdom, *Farm wastes, *Land disposal.

When planning a waste disposal system it is important to know how much and what kind of material will have to be handled. There are basically 5 systems of manure handling: (1) solid, (2) semisolid, (3) liquid slurry, (4) organic irrigation, and (5) discharge into a public sewer. Aerobic oxidation treatment systems include (1) the oxidation ditch, (2) the high rate biological filter tower and (3) the surface aerator. In addition to manure, silage effluent; washing down water; rainwater; and other water used in the milking process must be considered when designing farm buildings. In utilization of farm manure, it is normally recommended that diluted cow slurry (1 part manure: 2 parts water) should be applied at up to 15,000 gal. per acre per annum in three separate applications. The legal aspects of waste disposal are clarified by the Rivers Act of 1951 and 1961, the Water Resources Act of 1963, the Public Health Acts of 1961 and 1969, and the Agricultural Act of 1956. Infectious organisms of concern are the salmonella group of bacteria and brucellosis. The proper waste disposal system for a particular farm is dependent upon the type of land, acreage and cropping policy, type of housing, scale of enterprise, costs, river pollution, nuisance and health possibility of hazards, and comfort of stock and men. Care should be taken not to: agitate or empty storage tanks when the wind direction will carry smells to houses, operate spray guns in periods of high wind, irrigate when the land is saturated, or drain effluent directly into a water course. (Battles-East Central).

### 2408-A1, A2, B1, B2, B3, B4, C1, C2, E2, F1
### REVIEW PAPER: ANIMAL WASTES MANAGEMENT AND CHARACTERIZATION

Division of Environmental Engineering, College of Engineering, Utah State University, Logan.
J. E. Middlebrooks,
Water Research, Vol. 8, p. 697-712, 1974. 1 fig. 13 tab, 46 ref.

Descriptors: *Farm wastes, *Physical properties, *Chemical properties, *Agricultural runoff, *Waste treatment, *Nutrients, *Feedlots, *Confinement pens, *Locating, Lagoons.
Identifiers: *Waste management, *Land disposal, Retention ponds.

Agricultural-related environmental quality problems have received little attention until the last 10 years. The purpose of this report is to attempt to provide an overall picture of the characteristics and treatability of animal wastes and runoff from animal feedlots. The study showed that there is a wide variability in both the characteristics and performance of treatment facilities. Loehr (1972) proposed several feedlot runoff control measures, such as retention ponds, use of evaporation ponds, diversion, land disposal of the excess liquid and accumulated solid matter, confinement, and proper location. All of the above methods can easily be adapted to fit a particular situation under certain environmental conditions. Application of one or all of these methods depends on such factors as rainfall patterns for a particular area, rainfall amount and frequency, and geography. Location selection is possibly a key in the control of feedlot and animal waste pollution. Another significant factor in controlling feedlot and animal waste pollution is the number of waste management alternatives that are made available to a feedlot operator. However, it appears that the agricultural industry is incapable of absorbing the costs of conventional waste treatment at this time. Therefore, whenever possible, feedlot location should be such that the old reliable method of confinement and land disposal can be employed. (Penrod-East Central).

### 2409-A2, B2, C1, D2, F1
### CHEMICAL COAGULATION OF FEEDLOT RUNOFF

R. J. Smaus.
MS Thesis, Department of Civil Engineering, University of Nebraska, May, 1972, 60 p., 25 fig, 7 tab, 23 ref.

Descriptors: *Feedlots, *Agricultural runoff, *Chemicals, *Coagulation, *Costs, Turbidity, Sludge.
Identifiers: *Color reduction.

This investigation was undertaken to evaluate the treatment of feedlot runoff by chemical coagulation, with color reduction as the prime goal. The removal of organic material and other desirable effects were also anticipated. Alkalinity was shown to be important in the chemical coagulation process. Turbidity and apparent color can be reduced by the application of moderate amounts of coagulants, whereas the colloidal color, believed to be hydrophilic, requires large coagulant dosages for significant removal. The reduction of the total solids, suspended solids and COD may be related to the reduction of turbidity. Feedlot runoff can be clarified by coagulation using the common metalic coagulants. Estimated chemical costs of such treatment are in excess of $1.00 per 1000 gallons. From the chemical costs involved and the large volume of chemical sludge produced, chemical coagulation does not appear to be a practical method of treating this waste. (Cartmell-East Central).

### 2410-B2, B5, C1, D3
### SOLIDS REDUCTION OF BEEF CATTLE WASTES IN A SEMIBATCH-PROCESS OXIDATION DITCH

Area Livestock Specialist, Fort Dodge, Iowa.
B. B. Berven, M. P. Hoffman, H. L. Self, and S. W. Melvin.
Transactions of the ASAE, Vol. 18, No. 2, p. 316-318, 322, March-April, 1975. 1 fig, 4 tab, 7 ref.

Descriptors: *Waste treatment, *Cattle, *Confinement pens, *Energy, Microbial degradation.
Identifiers: *Oxidation ditch, *Semi-batch process, *Solids reduction.

The potential pollution problems from the livestock feeding industry and the development of greater concern for the environment are forcing many cattle feeders to look for better methods of controlling the waste from feeding facilities. The objective of this study was to evaluate solids reduction of beef wastes in a semi-batch-process oxidation ditch of a cold confinement facility with slotted floors. Data on solids-reduction were obtained from two test periods. The first period was from November 10, 1971, to April 12, 1972 and the second was from April 28, 1972, to October 4, 1972. Two procedures were used.

The first procedure assumed that the daily dry matter waste production per steer was 2.3 kg and total solid-reduction values of 32.6 and 32.0 per cent were obtained for winter and summer tests, respectively. The concept of the partitioning of energy in feedstuffs was employed in the second procedure. The total solids-reduction values of 28.1 and 27.2 per cent were obtained for the winter and summer tests, respectively. Tables are provided which show ration composition, and total solids reduction for both procedures. A schematic diagram of components of energy utilization and loss is also given. (Penrod-East Central).

## 2411-A2, A3, B1

### SURFACE RUNOFF IN DAIRIES

Department of Soil Science and Agricultural Engineering University of California, Riverside.
A. C. Chang, D. Aref, and D. C. Baier.
California Agriculture, Vol.29, No. 4, p. 16-17, April, 1975, 2 fig., 2 ref.

Descriptors: *Agricultural runoff, *Dairy industry, *Water pollution, *California, *Watersheds, *Hydrology, *Precipitation, Suspended solids.

Surface runoff usually carries a high water pollution potential if it comes from livestock-manured areas. In an area such as the Chino-Corona dairy preserve, which has a heavy concentration of livestock, manure-laden runoff could be a significant portion of the total surface runoff of the watershed and could degrade the quality of the receiving stream. The purpose of this study was to attempt to determine the hydrologic and water quality characteristics of surface runoff from this area. Researchers simulated precipitation on the surface of dairy corrals where animals are confined, rather than wait for runoff generating storms. A table is provided which summarizes the hydrologic characteristics of each delivered precipitation and its resultant runoff. The transport of suspended solids by overland flow did not appear to be a serious problem on mildly-sloped land, although the loss of dissolved minerals to surface runoff was significant. Channels have a tendency to be formed by overland flow traveling a long distance; this channelled flow with higher velocity would transport larger amounts of loosely-packed wastes. No channel was formed under experimental conditions. This information leads to the conclusion that a well-sloped corral surface would minimize the loss of suspended material through runoff. (Penrod-East Central).

## 2412-B2, C2, D3

### A STUDY IN A FULL-SCALE SWINE WASTE DISPOSAL SYSTEM

Institute of Environmental Sciences and Engineering, Toronto University, Canada.
P. H. Jones and N. K. Patni.
Water Research, Vol. 6, p. 1425-1432, 1972. 8 fig, 1 tab, 4 ref.

Descriptors: *Waste treatment, Biochemical oxygen demand, Chemical oxygen demand.
Identifiers: *Swine, *Oxidation ditch, *Ditch mixed liquor, Organic carbon, Odor control.

A problem of disposal of large amounts of animal wastes arises when confinement livestock breeding is utilized. This problem is especially great since there is an increasing trend towards this method of breeding and the problem is magnified when land application of the manure produced is not feasible. Because of their simplicity and economy, oxidation ditches are being considered more often as a means of partially or completely stabilizing livestock wastes. The objective of this study was to report findings on the biological efficiency of oxidation ditches in reducing organic carbon. This study showed that the oxidation ditch was a satisfactory unit for treating swine wastes for the reduction of BOD and COD loads. If the manure is mixed with poorly biodegradable bedding material, it is desirable to screen the wastes for large solid materials before introducing them into the ditch. It was advised that foaming be considered in the design of a unit, particularly when in-the-building oxidation ditches under slatted floors in the pens are used, as excessive foaming was often a serious problem. For odor control, better DO distribution in the entire ML mass is desirable. Two methods of achieving this are using extra rotors or using direct air injection into the ditch ML. (Penrod-East Central).

## 2413-A2,A5,A8,B1,C2,E1

### SUBSURFACE DISTRIBUTION OF NITRATES BELOW CHEMICAL CATTLE FEEDLOT, TEXAS HIGH PLAINS

Department of Geosciences, Texas Tech University, Lubbock.
W. D. Miller.
Water Resources Bulletin, Vol. 7, No. 5, p. 941-950, October, 1971. 5 fig, 2 tab, 3 ref.

Descriptors: *Feedlots, *Infiltration, *Nitrates, *Texas, *Groundwater pollution, *Agricultural runoff, Permeability, Ponds, Waste storage.
Identifiers: Subsurface distribution.

For several years, speculation has been rampant concerning the potential pollution hazard of commercial cattle feedlots to groundwater zone (Ogallala Formation) of the Texas High Plains. The major objectives of the study were: (1) determination of quantitative distribution of nitrogen and other chemical parameters below major feedlots, (2) evaluation of laboratory and field determined rates of nitrate movement from surface to watertable, (3) determination of the time-space distribution of ions in the saturated zone, and (4) the determination of what geologic environments in the High Plains are least conducive to infiltration of cattle feedlot runoff. Water samples were collected for quality analyses from beneath eighty commercial cattle feedlots in the Texas High Plains. The establishment of vertical gradients of dissolved solids was determined from the drilling and/or coring of twenty-two feedlots. Lots included in the study ranged in age from new installations to 35 years. Runoff collection-systems on lots include playas, dammed and undammed stream channels, and man-made ponds. Infiltration to the watertable below feedyards of feedlot liquid waste is insignificant in most localities of the Texas High Plains. Infiltration of "collected" feedlot runoff and subsequent concentration of dissolved ions in groundwater in the High Plains is dependent upon several factors. These factors are listed and discussed by the author. The study showed that certainly, no regional subsurface pollution problem exists today nor is one foreseen from cattle feedlot runoff in the Texas High Plains. (Penrod-East Central).

## 2414-A6, A10, A11, A12, B1, C2, C3, D2

### POULTRY MANURE: ITS PRESERVATION, DEODORIZATION AND DISINFECTION

New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey.
W. Yushok and F. E. Bear.
New Jersey Agricultural Experiment Station Bulletin No. 707, Rutgers University, 1948, 11 p. 8 ref., 7 tab.

Descriptors: *Poultry, *Farm wastes, *Preservation, *Disinfection, *Waste treatment, Ammonia, New Jersey, Fertilizers, Nitrogen, Drying, Costs, Bacteria.
Identifiers: *Deodorization, Superphosphate, Hydrated lime.

Conservation is an important word on the poultry farm. This calls for prevention of waste and the preservation of the health of the flock. The purpose of this report was to attempt to solve problems which deal with the handling of poultry manure. They are: (1) the product tends to lose much of its value, (2) it attracts flies and rodents, (3) it gives off disagreeable odors, and (4) it is a potential source of disease. Calculations made from the study data showed that 81 per cent of the N, 88 per cent of the phosphoric acid, and 95 per cent of the potash fed to hens are excreted in the manure. The contents of fresh manure produced by laying hens was found to be about 78 per cent moisture, 1.05 per cent N, 0.82 per cent phosphorus acid, and 0.51 per cent potash. A large percentage of nitrogen in untreated poultry waste was lost as ammonia, especially in warm weather. The most effective agent used in preventing the loss of nitrogen from poultry manure was superphosphate. At least 100 pounds of superphosphate should be added to one ton of fresh manure. Manure can be preserved by artificial drying, but this causes a loss of nitrogen, regardless of treatment with preservatives. Costs of dried product production are given. Hydrated lime was found to be the most effective deodorizer of poultry manure, also having a marked effect in reducing nitrogen losses from fresh manure. The addition of hydrated lime also improved the handling qualities of the product. Application rates of lime are provided. Hydrated lime was found to have bactericidal effect on paratyphoid, pollorum, typhoid, and fowl cholera organisms and it prevented coccidial parasites and large-roundworms' eggs from reaching infective stage. (Penrod-East Central).

## 2415-A1,B1,D2,E1,E2,E3

### CRITICAL WASTE PROBLEMS AHEAD

Kentucky University.
I. P. Ross, B. J. Barfield, and H. E. Hamilton.
Livestock Breeder Journal, Vol. 15, p. 270-272, 274, July, 1972.

Descriptors: *Agricultural wastes, *Waste disposal, Lagoons, Recycling
Identifiers: *Livestock wastes, *Waste management, *Pollution, Land disposal, Oxidation ditches.

Agricultural waste management problems have been magnified by recent developments—extension of the suburbs into farming areas, centralization of animal producing facilities, increased production, use of chemical fertilizers and demand for processed food. Many new practices and concepts are being tested and researched in an effort to solve these problems. Livestock waste pollution constitutes about 11 per cent of all agricultural pollution. Land disposal of these wastes is the most widely used disposal method. Microbial digestion systems such as lagoons and oxidation ditches rank second. Other systems include: dehydration to produce fertilizers, deep dispersal into drilled wells, and various methods of recycling. In summary, Theodore C. Byerly of the U.S. Department of Agriculture warns us, "As we attempt to resolve the problems of pollution, the systems we choose must not only be technologically effective, but also socially and economically acceptable." (Merryman-East Central).

## 2416-A6, A10, B3, B4, C1, C2, C3, D3, E2

### POULTRY MANURE COMPOSTING

J. M. Sweeten.
Fowl Tips Newsletter, Vol. 2, No. 4, p. 2-3, 1973.

Descriptors: *Aeration, *Forced drying, Thermophilic bacteria, Moisture content, Temperature.
Identifiers: *Composting, *Windrows, pH, Carbon-nitrogen ratio, Land disposal.

Composting of manure and litter before disposing of it on the land improves the wastes' handling characteristics, preserves nitrogen, and reduces odors and flies during storage and disposal. The objective of composting is to provide the ideal diet and environment for thermophilic bacteria. Proper aeration, moisture content, temperature, pH, and carbon-nitrogen ratio are critical. To reduce moisture content, improve aeration, increase carbon-nitrogen ratio, and reduce oxygen requirement, carbonaceous wastes (litter, sawdust, crop residues, etc.) may be added to manure. Initial pH should be 6.5 to 7.2. Final pH values will range from 8.5 to 9.0. Aeration is a key factor in composting. If forced air injection is used, initial aeration rates of 2.0 to 5.0 cubic feet of air per minute per cubic yard of compost (cfm/cu. yd.) should be provided in the beginning, with reduction to 1.0 cfm/cu. yd. during the third week, and with no further aeration needed after the fourth week. If windrows are used for composting, they should be no more than three feet high and should be turned at least three times a week for the first two weeks after the compost has heated to above 113 degrees F. Turning may be reduced to once a week during the next week or two. Turning may be terminated whenever the compost fails to regain a temperature in excess of 113 degrees F. The compost should then be aged in stockpiles for 60 days. (Merryman-East Central).

## 2417-B2,B3,B4,D3,E2,E3

### SOLID WASTE HANDLING

Pennsylvania State University.
A. R. Grout.
Dairy Herd Management, Vol. 11, No. 4, p. 12-13, 1974.

Descriptors: *Solid wastes, *Slurries, *Dairy industry, *Waste storage, *Storage tanks, *Storage requirements.
Identifiers: *Waste management, *Land disposal, *Stackers, *Free stall barns, *Manure ponds.

While processes such as dehydration, composting, and recycling into methane are being used on manure, the best bet for most dairymen is the use of cropland as the processing medium. This generally means that manure has to be stored until proper time for land disposal. Long elevators or mechanical throwing devices are needed for stall barn manure because it will not flow. Different methods for water removal from the manure are discussed. The manure itself is transported to a stacker enclosure which, in most cases, is built of reinforced concrete. Storage capacity is figured at 1.5 cu. ft. per 1,000 pound animal unit. Capacity of storage is usually planned for a period of six months or more. Roofs over these structures are optional but desirable. Manure storage for free stall barns is stored "as produced" as a heavy slurry with very little added bedding material. The free stall barn can be cleaned with a tractor scraper or by the new automatic scrapers. Conveyance to the storage basin can be by gutter cleaner chain, or by pushing the manure through an underground pipe with a special ram pump. The storage enclosure for this type manure is usually built below ground level with reinforced concrete walls on three sides. One end has a sloped entrance floor up to the wall level which allows manure to be brought up the ramp with a tractor loader. The spreader can be backed into the basin as the level recedes due to manure removal. Use of manure ponds with earth walls like a farm pond is also gaining acceptance for storage of this type of manure slurry. (Merryman-East Central).

## 2418-A6,A10,B2,B3,B4,E2,E3

### CHINO VALLEY SHAKER

Dairy Herd Management Editor.
G. Ashfield.
Dairy Herd Management, Vol. 11, No. 4, p. 22-27, April, 1974. 7 fig.

Descriptors: *Dairy industry, *California, *Fertilizers, Odor, Sprinkler irrigation.
Identifiers: *Waste management, *Storage pond, *Land disposal, *Bedding.

Manure is neither an asset nor a liability but simply one of two products of the more than 700 dairy animals housed at the C. S. Musser & Sons, Inc., producer-distributor dairy operation. The waste collection and handling program is organized with all the care and planning normally reserved exclusively for the prime dairy product, milk. In full cycle, the manure is flushed, pumped, separated, and stored in both solid and liquid form prior to its use as bedding and fertilizer. An intensive 13 month study was conducted to evaluate the workings of the waste retention pond. Specific goals of the study were to determine: (1) the effect of dairy waste as a pond sealant; (2) the chemical and biological action in, around and under the pond. The waste pond became effectively sealed from excess infiltration in not more than 55 days after inflow of screened dairy sewage. Odor emissions from the pond were not severe enough to create a neighborhood nuisance and the pond did not create a fly problem. Sufficient acreage of irrigated cropland to permit effective pond management and post-pond discharge of the contents is essential to make this type of pond and the accompanying waste disposal environmentally acceptable. (Cartmell-East Central).

## 2419-A11,A12,B3,C3,D2,D3, E3,F2

### ENSILED BROILER LITTER AND CORN FORAGE. 1. FERMENTATION CHARACTERISTICS

Department of Agriculture, Maryland University, Eastern Shore Princess Anne.
B. W. Ha[illegible]on, J. P. Fontenot and K. E. Webb, Jr.
Journal of Animal Science, Vol. 40, No. 1, p. 144, January, 1975. 10 tab, 29 ref.

Descriptors: *Feeds, *Poultry, *Fermentation, *Litter, *Coliforms, *Pathogenic bacteria.
Identifiers: *Refeeding, *Ensiled broiler litter, Food and Drug Administration, Corn forage.

Broiler litter is an accumulation of poultry excreta, feathers, wasted bedding and feed and is valuable as a feed for ruminants. The Food and Drug Administration does not sanction the practice of recycling broiler litter by feeding. There is apprehension concerning the dangers of pathogenic organisms in litter fed to livestock, although no serious health problems have resulted from feeding broiler litter. The objective of this study was to determine the feasibility of ensiling broiler litter and corn forage. This study gives the fermentation characteristics and microbial population studies of mixtures of different ratios of broiler litter and corn forage cut at two stages of maturity. All mixtures appeared to show typical fermentation characteristics and preserved well. By advancing maturity of corn forage and by each level of litter addition, the per cent dry matter in silage was significantly increased. The crude protein content of the silage was significantly increased by the addition of litter. The total bacteria counts of the silages exceeded 3 million bacteria per gram. The coliform population was generally higher for the control silages than for the silages containing litter. This trend for lower coliform numbers in litter silages than controls suggests that ensiling may be an economical means of eliminating potential hazards from the possible presence of pathogens in litter. Tables on mixture composition, total and ammonia nitrogen, fermentation characteristics, and the total count of bacteria and coliform for the various small and large-bag silages are given. (Penrod-East Central).

## 2420-B5,C1,C2,C3,E3,F1

### CANADIANS EXPLAIN ADVANTAGES, PROBLEMS IN FEEDING POULTRY LITTER

Feedstuffs, January 7, 1967, p. 46.

Descriptors: *Feeds, *Poultry, *Litter, *Canada, Proteins, Nutrients, Pathogenic bacteria.
Identifiers: *Refeeding, Broilers, Layers, Alberta.

A report made by the Alberta Department of Agriculture on feeding poultry litter is discussed. The report discovered that poultry litter analyses indicate a wide variation between samples. Reasons were most probably whether litter came from layers or broilers, the kind and amount of bedding used, amount of weathering or heating and management factors such as wastage, feed, etc. The study showed that the amount of bedding used is more important than the type of bedding. Using more bedding resulted in lower protein. Some generalizations on litter feed were given. Some of them are: (1) Vitamin D and A will require supplementing, (2) fiber content is not excessive, (3) nitrate levels on these samples, at least, were considerably below the 1.5 per cent danger level, however, this is one point where more information could be of value. The Department of Agriculture reported that disease hazards (salmonellosis, coccidiosis, and avian TB) are of some concern in litter feeding, but do not seem to provide major obstacles. The decreased cost of the litter ration is the cause for the enthusiasm for feeding litter rather than the increased gains. Keeping the litter and/or the mixed feed from heating up was a real problem, the Alberta operators agreed. Other problems and advantages are given. The Alberta report showed that the normal method of feeding litter is to hammer together a mixture of litter and grain. (Penrod-East Central).

## 2421-A1, B1, C1, C2, C3, E1, E2, F2

### WHOSE RESPONSIBILITY? CONTROL OF LIVESTOCK AND POULTRY WASTES

Michigan State University.

Draft No. 3, Agricultural Engineering Department and Cooperative Extension Service, Michigan State University, August 4, 1971. 10 p.

Descriptors: *Waste disposal, *Legal aspects, *Michigan, *Livestock, *Poultry.
Identifiers: *Waste management, *Pollution, *Land disposal.

The purpose of this study is to provide information on pollution and pollution control for livestock wastes. Pollution is defined in terms of Michigan Law. There are several common agricultural pollutants. The major causes are animal odors and wastes, soil sediment and agricultural chemicals. Other pollution sources are fuels, soil particles, dead animals, noise, trash, smoke and garbage. Water pollution potential of animal wastes is defined in terms of (a) organic oxygen consuming characteristics, (b) bacteriological quality, (c) suspended solids, and (d) nutrients. The various Michigan state agencies and their functions and responsibilities are discussed. Agencies and departments from which farmers can obtain various financial assistance are listed. Some conditions which greatly increase the potential of pollution by livestock or poultry wastes are given. Among them are: (1) a major livestock facility expansion, (2) spreading of wastes on frozen ground, and (3) high concentrations of livestock or poultry. General good rules to follow for land application are given. Alternate methods of disposal are given. The report states that the farm operator is responsible for making sure that pollution does not result from his farming operation, and gives ways in which he can avoid pollution. Site selection and land area for waste disposal are two important considerations when planning an operation expansion. The report gives the acceptable systems that are now available for disposing of animal wastes and lists other sources of agricultural pollution. (Penrod-East Central).

## 2422-B3, C1, C2

### WEATHERING OF ACCUMULATED WASTES IN UNROOFED AND UNPAVED CONFINED LIVESTOCK OPERATIONS,

Department of Soil Science and Agricultural Engineering, California University, Riverside.
A. C. Chang and D. S. Adriano
Journal of Environmental Quality, Vol. 4, No. 1, p. 79-82, January-March, 1975. 4 fig., 2 tab, 16 ref.

Descriptors: Confinement pens, Farm wastes, Weathering, Cattle, Dairy industry, California, Chemical properties, Physical properties
Identifiers: Waste decomposition, Waste distribution

Animal waste may accumulate on the ground surface several months in an open, unpaved livestock confinement prior to collection and disposal. A beef and a dairy cattle confinement operation were sampled after 2 months of waste accumulation to determine waste accumulation patterns and the effect of natural weathering on the characteristics of deposited wastes and waste stability. The study ascertained that 50 percent of the total waste produced was concentrated in 25 percent of the surface area. Moisture content of waste from the beef cattle feedlot is usually higher than that from the dairy lot. Stability of the waste measured as TN/FS or as COD/FS, indicated there was only 15-20 percent decomposition of waste during the 2 months' accumulation. The samples collected, however, indicated the accumulating waste was unstable and would undergo further decomposition at a suitable environmental condition. Between the two confinement units, there appeared to be little difference in the weathering of accumulated wastes. This was attributed to the management operations of the two units. (Penrod-East Central)

### 2423-A8, C2, E2
## VALUE OF MANURE ON AN IRRIGATED CALCAREOUS SOIL,

Kansas Agricultural Experiment Station, Kansas State University, Garden City.
G. M. Herron and A. B. Erhart
Soil Science Society of America Proceedings, Vol. 29, p. 278-281, 1965. 7 fig, 3 tab, 17 ref.

Descriptors: Nutrients, Nitrogen, Phosphorus, Grain Sorghum, Yields.
Identifiers: Manure, Land application, Soil fertility

Quality is important when manure is sold as fertilizer rather than disposed of as waste material; yet, little if any emphasis is placed on manure "quality." The objective of this study is to attempt to evaluate "high quality" manure in comparison to commercial fertilizer. Data from such a study should help determine the economy of manure disposal and or use. The study showed that each ton of high quality manure was equivalent to 22 lb. of nitrogen from ammonium nitrate as measured by equivalent grain sorghum (Sorghum vulgare Pers.) yields over a 4-year period. When both manure and N were applied, maximum yields were attained. The relative yield of grain correlated better with nitrogen removed in the grain than nitrogen removed in total above-ground portion of the grain sorghum plant. Based on the results of the study, high quality manure could be valued at about two-thirds to three-fourths of its total N content for sorghum production. On soils that need P, K, trace elements, or improved physical condition, some additional value would be justified. Using the Bray and Kurtz no. 1 procedure, the phosphorus level of the soil was increased by 1 ppm for each ton of applied manure. (Penrod-East Central)

### 2424-A6, C2, F6
## VOLATILIZATION OF NITROGEN-CONTAINING COMPOUNDS FROM BEEF CATTLE AREAS,
U. S. Department of Agriculture, Lincoln, Nebraska
L. F. Elliott, G. E. Schuman, and F. G. Viets, Jr.
Soil Science Society of America Proceedings, Vol. 35, p. 752-755, 1971. 4 fig, 2 tab, 10 ref.

Descriptors: Feedlots, Cattle, Pastures, Odor, Ammonia, Nitrogen compounds, Sampling, Soil temperature.
Identifiers: Volatilization, Steam distillation, Amines, Mounding.

Volatile N-containing compounds are found in chicken and swine manure and some or all of these compounds probably volatilize from cattle manure, along with $NH_3$, and contribute to odor. The object of this study is to determine the distillable and nondistillable nitrogen that contributes to odor from feedlots. The release of steam-distillable organic N compounds and $NH_3$ to the atmosphere from a small beef feedlot and a pasture was measured. Study data indicated that the quantities of distillable N being released were increased by surface disturbance such as mounding. Results also indicated that ammonia evolution is soil temperature-dependent, $NH_3$ volatilization increasing with increased temperatures in the spring. Throughout the year, distillable N trapped in the cropland was much less than that trapped at the feedlot site. The yearly average values were 148 kg/ha per year for the acid trap next to the feedlot and 16 kg-ha per year for the cropland trap, a significant difference at the 5 per cent level as determined with the F Test. The same traps averaged 21 and 3.3 kg/ha per year, respectively, of organic N compounds that weren't recovered in a 3-minute steam distillation procedure. Tests showed that although most amounts were too low to be measured accurately, some aliphatic amines were present in the trapping solution. (Penrod-East Central)

### 2425-D1,D2,E2,F1,F2,F4
## UTILIZING WASTES IN ANIMALS FEEDS--A EUROPEAN OVERVIEW,
Agricultural Research Council's Poultry Research Center, Edinburgh, Scotland
R. Blair
Feedstuffs, Vol. 47, No. 26, p. 16, 33-34, 44, June 30, 1975. 6 tab, 16 ref.

Descriptors: Recycling, Organic wastes, Europe, Legislation, Proteins, Cellulose, Farm wastes, Industrial wastes.
Identifiers: Refeeding, DPW, Single-cell protein, Hydrocarbons.

There are two main incentives for waste recycling to aid in pollution abatement. One is that wastes might safely be recycled for refeeding and the other is that it might be a profitable enterprise for the sector of the industry concerned. Even though there is a need for increased use of indigenous proteins, animal foodstuffs quality is governed by legislation. Legislation differs within the European Economic Community (EEC) and harmonization is not expected to take place for a few years. The legislation of several countries within the EEC is briefly discussed. Various changes in these legislations are also examined. The systems for drying which can give a possible profit incentive are given. The use and processing of straw, wood and other cellulosic wastes for use in animal foods is explained, along with possible drawbacks. Industrial wastes that are dealt with in the capacity as possible food supplements for animals are: (1) spent liquor left after the fermentation of alcohol, yeast, citric acid and other products, using molasses as substrate and organisms such as yeasts or Aspergillus niger, and (2) coffee pulp, hulls and grounds. These wastes can be processed directly for inclusion in animal feed but another approach is to use them as substrates for single-cell protein SCP production. One of the most promising sources for this type of production is the suphite liquor from large paper mills. The use of hydrocarbons in SCP production is examined. However, the use of hydrocarbons is more expensive in SCP production than the use of wastes. (Penrod-East Central)

### 2426-A12,D1,D3,E2,F6
## USE OF SLUDGE RELIEVES 'FERTILIZER SHORTAGE'.
Ecosystems, Vol. 5, No. 7, p. 7, April, 1975.

Descriptors: Recycling, Energy, Fertilizers, Sludge disposal, Municipal wastes, Feedlots, Delaware, Maine, Missouri.
Identifiers: Shredding, Composting, Land disposal.

According to EPA administrator Russell E. Train, the 120 per cent price rise in commercial fertilizers since 1973 may make the use of organic material such as municipal sludges and feedlot wastes an economic necessity in the future. However, not all sludges could be used for soil improvement because in some cases the waste might contain excessive concentrations of viruses or metals that could be hazardous to health. A demonstration project in Delaware will include compost production and facilities to enrich the product with synthetic fertilizers. The project will test the concept of plowing under shredded solid waste and sewage sludge for soil enrichment. Marketing value will also be explored. A demonstration project is also being set up in Maine to demonstrate a new and simple sludge composting technology developed by the Department of Agriculture. One other EPA-supporting demonstration project will be an energy recovery system in St. Louis. This system shreds the waste and separates the organic from the inorganic materials. Both materials are now being used for energy production because of the heavy demand for energy, although the organics could be used in soil conditioning if demand warranted. Mr. Train concluded that now is perhaps the time to change old tendencies toward the disposal and destruction of residuals and waste. (Penrod-East Central)

### 2427-A11, F2
## USE OF DRIED POULTRY WASTE IN DIETS FOR CHICKENS,
Department of Animal Science, Iowa State University, Ames 50010
N. Trakulchang and S. L. Balloun
Poultry Science, Vol. 54, No. 2, p. 609-614, March, 1975. 8 tab, 10 ref.

Descriptors: Diets, Performance, Amino acids, Proteins.
Identifiers: Poultry, DPW, Broilers, Laying hens, Nitrogen utilization, Egg production, Feed conversion efficiency.

The purpose of this study was to determine whether DPW could be utilized as a beneficial feedstuff by chickens. Two experiments with broiler chicks and one with laying hens were utilized in examining the effects of dried poultry wastes on poultry. Experiment 1 indicated that DPW at 10 per cent, without amino acid supplementation, did not affect weight gains and feed efficiency of young chicks, but 20 per cent DPW without added amino acids greatly depressed growth and feed efficiency. The experiment further indicated that supplemental amino acids contributed more utilizable nitrogen to the DPW diets. Experiment 2 revealed that DPW at 10 per cent of the diet, with true protein maintained at 22 ± 0.5 per cent, did not significantly affect weight gains or field efficiency. Experiment 3 showed that for laying hens, beyond their peak of production, DPW decreased rate of egg production and efficiency of feed conversion and increased mortality. (Penrod-East Central)

### 2428-A6, A11, B1, B4
## UNDERFLOOR VENTILATION FOR SLOTTED FLOOR SWINE BUILDINGS,
Department of Agricultural Engineering, College of Agriculture, Illinois University, Urbana-Champaign
A. J. Muehling
Agricultural Engineering Tips, Farm Buildings No. 35, December, 1974, 5 p. 2 fig, 3 tab.

Descriptors: Ventilation, Design, Carbon dioxide, Ammonia, Hydrogen sulfide, Methane.
Identifiers: Air inlets, Louvers, Fans, Slotted floors, design formula.

The four main gases produced by manure stored in a tank or pit are ammonia, methane, carbon dioxide and hydrogen sulfide. The amount of gas produced depends on the length of time the manure is in storage, the volume of manure involved, its temperature, and other factors. In terms of the amount of gas released into the building, the amount of mixing or agitation is a very important factor. There is some concern regarding the long-range effect on operators and small pigs that spend long hours in swine production facilities that use pits or tanks. Proper ventilation is felt to be important to their health. The amount of ventilation usually depends upon the weather (among other things). The main purpose of winter ventilation is for moisture and odor control. The primary purpose of ventilation in the summer is to control the building temperature. The requirements for an underfloor ventilation system are listed. The various components of the system are discussed. Air inlets should distribute the air uniformly through the building. The purpose of louvers is to allow the air to enter the attic.

A central duct permits uniform ventilation throughout the buildings. Properly sized openings from the pit to the duct allow the air to flow uniformly from the pit into the central duct. The placement, controls and types of fans are discussed. The report concludes with a design example in calculating the underfloor ventilation needed. (Penrod-East Central)

### 2429-A4, B2, D1, E1, F2
### RACEWAYS; EXOTIC SPECIES MOST AFFECTED BY PROPOSED E.P.A. DISCHARGE PERMITS,
Associate Professor, School of Forestry and Wildlife Management, Louisiana State University.
D. D. Culley, Jr.
The American Fish Farmer, Vol. 4, No. 8, p. 9-12, July 1973.

Descriptors: Regulation, Permits, Waste water pollution, Fish farming, Lagoons, Filtration, Recirculated water.
Identifiers: Non native fish.

The proposed amendment of Part 125, Title 40 of the Code of Federal Regulations will affect the licensing control of pond and raceway aquaculture facilities discharging wastes more than 30 days yearly and of non-native aquatic animal productions. Raceway facilities having continuous discharge would require licensing or converting to recirculating filtration or lagoon holding systems. A permit system should serve as an incentive for aquaculturists to become more efficient in their operations. There is reason to believe that through increased efficiency of reclaiming wastes or recirculating his water, the culturist can increase profits. (Hargrove-East Central)

### 2430-A6, B2, D2, E2
### ODOR REDUCTION FOR LIQUID MANURE SYSTEMS,
Environmental Hygiene Department, Karolinska Institute, Sweden
T. Lindvall, O. Noren, and L. Thyselius
Transactions of the ASAE, Vol. 17, No. 3, p. 508-512, May-June, 1974. 4 fig, 5 tab.

Descriptors: Odor, Measurement, Liquid wastes, Injection, Waste disposal, Sampling, Equipment, Cattle, Waste treatment.
Identifiers: Land spreading, Odor reduction, Swine.

In this investigation, different treatment and spreading methods of liquid manure have been compared from the odor point of view. The analyses were carried out with sensory methods under half-scale field conditions. A mobile odor laboratory with sampling equipment carried out parcel experiments on various types of ground (fallow, grassland, and stubble) treated with animal wastes, during different seasons (spring and autumn) and with general tillage implements and spreading equipment. The odor threshold values are expressed as the log dilution factor necessary to attain odorlessness. It was concluded that burial of manure results in a substantial reduction of the odor emission in connection with spreading. Burial is the method which at present can be recommended for this purpose. In areas close to dwellings, injection of manure into the soil can be valuable. By this means, odor emmission, as well as nutrition loss to air and water, are reduced. Of the different methods for manure treatment investigated, the addition of ammonium persulphate to swine manure showed a good effect. (Cartmell-East Central)

### 2431-B5, C1, C2
### NUTRITIVE PROPERTIES OF BROILER EXCRETA AS INFLUENCED BY ENVIRONMENTAL TEMPERATURE, COLLECTION INTERVAL, AGE OF BROILERS AND DIET,
U. S. Department of Agriculture, Agricultural Research Service, South Central Poultry Research Laboratory, State College, Mississippi 39762
L. F. Kubena, F. N. Reece, and J. D. May
Poultry Science, Vol. 52, No. 5, p. 1700-1703, September, 1973. 4 tab, 9 ref.

Descriptors: Nutrients, Temperature, Age, Diets, Amino acids, Proteins, Moisture content.
Identifiers: Broilers, Excreta, Collection interval, Lysine, Methionine.

The purpose of this research was to identify the influence of environmental temperature, collection interval, dietary amino acid levels, and age of broilers on excreta composition. In one trial, diets were calculated to contain 80, 100, or 120 per cent of the recommendations for lysine and methionine plus cystine. Three diets were fed to 5-week-old broilers maintained in 3 chambers having temperatures of 21.2 degrees, 21.1 degrees and 32.2 degrees C. These broilers were kept here for a 5-8 week experimental period. In the second trial, broiler chicks were fed a diet containing approximately 21.7 per cent protein and a metabolizable energy value of 3285 kilo-calories per kilogram. The results of trial 1 show that the total protein equivalent in the excreta increased with the age of the birds. The moisture content of the excreta decreased as the birds increased in age. Total protein equivalent, total amino acids, and ether extract increased with increasing dietary amino acid levels. There was a more dramatic increase in total protein and total amino acid in the excreta from the birds given the diet containing 120 per cent of the recommendation for lysine and methionine plus cystine when compared to the excreta for the birds given 100 per cent of the recommendations. The results of trial 2 show no consistent differences for individual amino acids, total amino acids, total protein equivalent, or ash that was due to environmental temperature or to collection interval. (Cartmell-East Central)

### 2432-A10, B1, B2, B3, B4, D3, F2, F4, F6
### LIVESTOCK WASTE MANAGEMENT CONFERENCE,
Illinois University
Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, 118 p. 32 fig.

Descriptors: Livestock, Illinois, Legal aspects, Feedlots, Design, Waste storage, Solid wastes, Liquid wastes, Lagoons, Research and development.
Identifiers: Waste management, Flushing, Mechanical aerators, Holding ponds, Mosquito control, Land disposal, Pumping, Application rates.

The main objective of the conference was to discuss the planning and design requirements for components of livestock waste management systems, particularly in Illinois. The status of Illinois livestock waste management regulation was discussed in relation to federal regulations. Storage structures for solid and liquid manure systems were examined. In relation to liquid manure disposal, recommendations on the selection of pumps, piping, sprinklers and nozzles were provided. Another aspect of manure-handling was the use of hydraulic flushing to dislodge and transport livestock manure from the deposit point to the place of disposal. Various mechanical aerators were examined as to whether they were preferable to rotors for use in oxidation ditches. The oxygenation and flow characteristics of the aerators were also discussed. The design and construction criteria of holding ponds and lagoons were considered. Another report considered the problem of mosquito control in disposal lagoons. Several factors that determine the application rates of livestock wastes to land were examined. Several projects dealing with animal waste management with pollution control were briefly presented in the Annual Report of Cooperative Regional Project. Waste-handling systems for three food production units were briefly presented. The units involved were a hog production unit, a beef production unit, and a dairy production unit. (Penrod-East Central)

### 2433-A1, B1, F2
### STATUS OF THE ILLINOIS LIVESTOCK WASTE MANAGEMENT REGULATIONS,
Agricultural Specialist, Division of Water Pollution Control, Illinois Environmental Protection Agency, Springfield
J. F. Frank
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. A1-A5.

Descriptors: Illinois, Legal aspects, Feedlots, Permits, Design.
Identifiers: Waste management, Regulations, Sanitary Water Board, Environmental Protection Agency.

In its later years of existence, the Illinois Sanitary Water Board (SWB) conceived the need for a set of livestock waste management regulations. On July 1, 1970, the SWB's activities were taken over by the Illinois Environmental Protection Agency (EPA). This agency continued the formulation of the livestock waste management regulations. The hearing process and the Illinois EPA's role and position are discussed. Federal regulations are then examined. The U.S. EPA published on December 5, 1972, a proposed set of regulations which covered some agricultural operations. Agricultural interests gave extensive response and a task force was set up to evaluate the responses and, if necessary, redraft and clarify the proposal. A new proposal was drafted during a two-day meeting of this task force which was held on January 29, 1973. After several public meetings with environmental groups, the proposed regulations were published in the Federal Register and a 30-day comment period was set. The operators of the various classes and sizes of feedlots or livestock shelters (as listed in a table) must apply for permits, although they do not necessarily need them. Future plans of the Illinois EPA are discussed. (Penrod-East Central)

### 2434-A2, A4, B3, B4
### STORAGE STRUCTURES FOR SOLID MANURE,
Department of Agricultural Engineering, Wisconsin University, Madison
J. C. Converse and C. O. Cramer
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. B1-B12. 8 fig, 1 tab, 9 ref.

Descriptors: Waste storage, Solid wastes, Separation Techniques, Design criteria, Agricultural runoff, Liquid wastes, Seepage, Nutrients.
Identifiers: Stacking.

Manure stacking in the winter is not a recent development in dairy operations. Interest is increasing in stacking manure for freestall housing where very little bedding is used, although manure stacking is best adapted for stanchion-type housing with bedding systems. Runoff from manure stacks located near streams can cause stream pollution, so care must be taken in choosing a site for the stack. Manure-handling systems also have to be designed to maintain good farmstead sanitation, particularly with dairy operations. Summertime stacking may put a greater demand on farmstead sanitation. The objective of this report is to review the storage of solid manure, discussing the various types of structures, management and problems in using the system. Research is currently underway to design optimum storage facilities that will minimize pollution, that will be economical, and that will not distract from the aesthetics of the farmstead. The manure storage system can be a good management tool, if properly designed. Storage structure size is dependent on the number of days of storage, the number and size of the animals, the type of manure handling needed, and the type and amount of bedding used. Other conclusions and recommendations cover bunker-type storage, seepage from a stack, and the emptying of detention ponds. (Penrod-East Central)

### 2435-B2, B4

### MANURE STORAGE TANKS FOR LIQUIDS,

J. O. Curtis
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. C1-C8. 2 fig, 2 tab, 3 ref.

Descriptors: Waste storage, Liquid wastes, Design.
Identifiers: Manure storage tank.

In recent years, a fairly large number of manure storage tanks for liquids have been constructed on farms with many more anticipated to be constructed in the future. Most of these tanks are located either outside the livestock building but nearby or under the floor of the building. The objective of this report is to discuss the available basic information that is related to tank design, illustrate its use, point out reasons for recommended variations, and to review some aspects of the Midwest Plan Service (MWPS) tank design. Available basic design information is given with respect to design loads, and the designing of manure storage tanks to resist loads. The report concludes that MWPS Plan 74303 is probably the best generally available plan for liquid manure tanks. It is a fairly conservative design with respect to the amounts of temperature and shrinkage, steel required, and the soil pressures assumed. In the future, the promotion of less conservative designs than the MWPS Plan may more safely be undertaken as more experience is gained with manure tanks and as more follow-up information is obtained on any tank failures. (Penrod-East Central)

### 2436-A6, A11, B2, B4, D1, D3, E2, E3

### MANURE-HANDLING BY HYDRAULIC FLUSHING

Department of Agricultural Engineering, Iowa State University, Ames
T. E. Hazen
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. D1-D11. 3 fig.

Descriptors: Design, Liquid wastes, Recycling, Confinement pens, Waste storage, Waste treatment, Pumping.
Identifiers: Hydraulic flushing, Dosing syphon, Tipping basket, Land disposal.

This report describes the design and application of systems that use a flowing liquid to dislodge and transport livestock manure from the point of deposit to the place of disposal. Enclosed confinement makes hydraulic collection and transport of manure a feasible method. There is some means for manure collection, transport, treatment, storage and disposal in any waste-handling system. In hydraulic flushing, it should be recognized that this method magnifies by 10 to 100 the amount of material put into motion. That a uniform flow is established along the entire length of the channel is assured by the flushing duration being long enough. There are several flushing devices. Among them is the dosing syphon which is a highly reliable and almost maintenance free means of rapidly discharging large volumes of stored liquid at a controlled rate and for a desired duration. Recycling requires no extra storage in a system other than to assure that the needed quantity and quality of liquid for the flushing devices is always available. Aerobically stabilized liquids can be handled by most of the conventional commonly available pumps, if properly screened. Some liquid will need to be removed periodically from any manure-handling system unless evaporation, seepage, or other losses are unusually high. Three major concerns still exist in the recycling system: (1) Ingestion and flushing liquid by livestock could aggravate transmission and prolongation of disease, (2) potential odor production, and (3) Repair or replacement of a return pump. (Penrod-East Central)

### 2437-B2, D1, D3

### OXYGENATION AND FLOW CHARACTERISTICS OF MECHANICAL AERATORS,

Department of Agricultural Engineering, Illinois University, Urbana-Champaign
J. K. Mitchell and D. L. Day
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. E1-E13. 7 fig, 1 tab, 9 ref.

Descriptors: Aeration, Oxygenation, Equipment, Flow characteristics.
Identifiers: Oxidation ditch, Mechanical aerators.

Increased interest in aerobically treating livestock wastes has led to a proliferation of aerobic methods and devices. Studies were conducted at the University of Illinois with two main objectives: (1) to determine the relative efficiency of three types of aerators with respect to oxygenation and liquid flow, and (2) to determine if some modification could be made to eliminate the areas of solids deposition by studying flow patterns in an oxidation ditch. The report data showed that some type of standardization by manufacturers and researchers in reporting the oxygenation and flow efficiency of various aerators is needed. The most useful index for comparing oxygenation efeciencies between aerators is the common parameter of oxygenation rate in pounds of oxygen per kilowatt hour. A flow/power parameter, in c.f.s./kw., may be a useful index if the liquid flow velocity is of concern for a particular oxidation ditch design. That the areas of low velocity, and hence, areas of potential settlement can be reduced with some form of center-wall and end section modification was shown by the flow pattern study. Before choosing a particular aerator device for a particular system, the different installation, maintenance, and operation advantages and disadvantages of each device should be considered. (Penrod-East Central)

### 2438-A2, B2, D3, E1

### DESIGN AND CONSTRUCTION OF HOLDING PONDS AND LAGOONS,

Soil Conservation Service, Champaign, Illinois
P. Christensen
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. F1-F9. 1 tab.

Descriptors: Waste disposal, Lagoons, Agricultural runoff, Design criteria, Settling basins.
Identifiers: Holding ponds.

Waste management facilities must be designed, planned, and constructed to permit the operator to efficiently manage waste production and effectively minimize potential pollution hazards. The major components of waste management systems are manure-storage structures, holding ponds, and disposal lagoons. This report discusses the design and construction of holding ponds and disposal lagoons. A holding pond is an impoundment for the collection and temporary storage of contaminated runoff from areas having concentrated animal waste. These ponds should be located as near the source as feasible, giving due consideration to odor and wind patterns. They should be located on watertight soils or on soils that seal easily. Settling basins are installed between the feedlot and holding pond to minimize frequent hauling of solids from holding ponds, to lengthen their life and to facilitate removal of stored contaminated runoff. The mean velocities of channels used for settling basins should be approximately 1 foot per second to permit settling of solids. The design and management of holding ponds are discussed. Disposal lagoons are defined as being impoundments made by constructing embankments or excavating areas to create a reservoir for biological stabilization and storage of organic waste. Lagoon design must consider all state and local regulations. Lagoon sight conditions are discussed. For design purposes, lagoons are commonly grouped according to their predominant biological characteristics: anaerobic, aerobic, or facultative. Each type of lagoon is examined individually. Lagoon design, operation and maintenance is discussed. Recommendations for holding pond and lagoon operation and maintenance are listed. (Penrod-East Central)

### 2439-A9, A10, A12, D2

### MOSQUITO CONTROL IN LIVESTOCK WASTE LAGOONS IN ILLINOIS, 1972,

Professor of Agricultural Entomology and Entomologist, Illinois Natural History Survey; Research Assistant, Illinois Natural History Survey
S. Moore III and J. Tranquilli
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. G1-G3. 1 tab.

Descriptors: Lagoons, Mosquitoes, Larvicides, Vectors.
Identifiers: Chemical control, Vegetation removal.

During recent years heavy populations of the northern house mosquito, *Culex pipiens pipiens*, have been observed breeding in livestock waste lagoons. This insect's presence is of great concern as it is a vector of the virus causing human encephalitis. This study's objective was the devising of effective and yet practical methods of control of the vector in animal waste lagoons. Both chemical and cultural controls were utilized. For the study, seven livestock waste lagoons on the animal science research farms at Urbana-Champaign were used. A heavy growth of marginal vegetation conducive to mosquito breeding was around each of the lagoons. Two lagoons (OSF and MA) were selected for the cultural control method, involving the removal of the marginal vegetation and floating debris. Three of the lagoons were selected for the chemical treatment method of control of mosquito larvae. The remaining two lagoons (Physiology and MD) were left untreated as controls. The study showed that the cultural control method reduced house mosquito larval populations to near zero. Until the marginal vegetation became flooded, significant mosquito larval populations did not appear in the untreated MD lagoon. An increase in larval populations was noted for OSF and MA when a regrowth of vegetation occurred. Flit MLO treatments and Malathion both effectively suppressed mosquito larval populations for about one week. Recommendations for lagoon design, vegetation removal, and chemical treatments for suppressing mosquito larval populations are listed. (Penrod-East Central)

### 2440-A6,A7,A10,A11,B1,B2, B3,C2,D3,E3,F5,F6

### REVIEW OF LIVESTOCK WASTE RESEARCH AT THE UNIVERSITY OF ILLINOIS--ANNUAL REPORT OF COOPERATIVE REGIONAL PROJECT,

Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. H1-H11.

Descriptors: Research and development, Livestock, Swine, Proteins, Feedlots, Cattle, Rain, Anaerobic conditions, Aerobic conditions, Equipment, Sheep, Nitrogen, Fish, Mosquitoes, Gases, Dusts.
Identifiers: Illinois University, Waste management, Pollution control, Refeeding, Erodibility, factor, Odor control, Municipal digester sludge, Oxidation ditch.

All of the projects reviewed concern animal waste management with pollution control. The various projects are described briefly and the progress of work and principal accomplishments of each are discussed. The projects are: (1) Refeeding of aerobically-processed swine waste, (2) Optimum rate of harvesting protein from aerobically processed swine wastes, (3) Erodibility factor for beef cattle feedlots exposed to rain, (4) Odor control and degradation of swine manure under anaerobic conditions by adding municipal digester sludge, and (5) Testing of aeration equipment for livestock oxidation ditches. Related research projects include: (1) The nutritive value of sheep feces. (2) Nitrogen as an environmental quality factor, (3) Fish culture and mosquito control in livestock waste ponds, and (4) Effect of gases and dust on swine. Work planned for the following year of 1973 is listed. (Penrod-East Central)

2441-B2, E2

### SELECTION OF PUMPS, PIPING AND WASTE DISTRIBUTION EQUIPMENT FOR LIQUID MANURE DISPOSAL,

President, Sprinkler Irrigation Corporation, East Peoria, Illinois
R. Schneider
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. 11-112. 3 fig.

Descriptors: Equipment, Liquid wastes, Waste disposal, Pumps, Pipes, Clogging, Irrigation, Erosion, Compaction, Temperature.
Identifiers: Selection criteria, Nozzles, Sprinklers, Gated pipe.

Pumping of animal waste on open land is fairly new in the United States, although this method of animal waste disposal has been used for many parts of the world. The objective of this report is to discuss the selection of pumps, piping, and waste distribution equipment for liquid manure disposal. Two primary types of pumps are described. The first type, low head, is designed to move a mixture of liquids and solids from the sump pit to the settling basin. The kinds, sizes and selection of this type of pump are discussed. The second type of pump, the high head, moves large volumes of liquid over long distances at high pressures. The two primary considerations in pipe size selection are: (1) the amount of liquid to be pumped, and (2) the horizontal distance the liquid must be pumped. The understanding of nozzle size and nozzle pressure relationship is important in order to properly select sprinklers and nozzles for effluent distribution. The primary limitations on nozzle size selection are compaction, erosion, crop damage, and wash. The pros and cons of gated pipe are discussed. If pumping is done in freezing temperatures, the main objective is to keep the water moving to avoid freezing of the effluent. The report concludes with a comparison of hauling and pumping as far as adaptability to different needs. (Penrod-East Central)

2442-A3, A4, A8, C2, E2

### DETERMINING APPLICATION RATES OF LIVESTOCK WASTES TO THE LAND,

Soil Fertility Extension, Illinois University, Urbana-Champaign.
S. R. Aldrich
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. J1-J12. 1 fig, 1 tab, 26 ref.

Descriptors: Farm wastes, Livestock, Poultry, Nitrates, Water pollution, Groundwater pollution, Phosphorus, Salts, Ammonia, Denitrification, Agricultural runoff.
Identifiers: Land disposal, Application rates, Yields.

Much trial and error has occurred in trying to determine the application rates of livestock wastes to the land. The objective of this report is to examine the disposal on agricultural land of collected animal wastes. The study showed that the safest program for manure disposal consists of 10-20 tons of large-animal waste or 5-10 tons of poultry waste per acre per year applied for the purpose of efficient utilization by responsive crops. In the immediate future, the permissable manure loading on agricultural land will be determined by the amount of nitrogen. Between 150 and 250 pounds is the amount of nitrogen that can be introduced into the soil annually without substantial buildup in $NO_3$. Poorly drained, fine-textured soils are sites that maximize denitrification and will tolerate heavier rates than well-drained, coarse-textured soils. The permissible rate of manure may be increased if the receiving water is low in nitrate and is large in volume relative to the water from the manured area. Where the water is discharged to a lake or reservoir directly or via a stream, the amount of phosphorus in drainage water may be the limiting factor in waste application. Ammonia concentration or salt concentration or both may limit the amount of manure that can be applied at one time without injuring germination and plant growth. On sloping land where runoff into surface waters is likely with normal rainfall, large surface applications are not acceptable. Future designing of large livestock operations must include proper waste disposal in the planning. (Penrod-East Central)

2443-B2, B4, E2

### OUR WASTE-HANDLING SYSTEM FOR HOGS,

Gehlbach Pork Farms, Inc., Lincoln, Illinois
G. D. Gehlbach
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. K1-K2.

Descriptors: Lagoons.
Identifiers: Swine, Land application, Slotted floors, Application rates.

Gerald Gehlbach traces the waste handling measures utilized on Gehlbach Pork Farms from 1961 to the present time. At present, Gehlbach farms produces over 8,000 hogs annually in a farrow-to-finish production-line type of operation. All market production is housed in environmentally controlled, totally slotted floor buildings with liquid manure pits below the slats. For waste disposal, a 7.5 acre waste lagoon is used in combination with hauling to cropland and injection into the soil. Acreage utilized for corn production has increased over the years as amount of animal wastes for disposal have increased. In the fall of the year every attempt is made to pump empty all of the pits below the slats and field-apply the manure prior to the fall plowing of corn fields. The normal application rate at this time is 20-25 tons of liquid manure per acre. Hauling is resumed in the spring when applications can be made on the remaining unplowed fields. During the summer the manure is again knifed into the soil on the cropland set aside from corn production in the Feed Grains Program. Because of acreage limitations, the application rates are usually higher here. The 7.5 acre lagoon is utilized for collection of the wastes during the winter when manure cannot be injected into the soil and during rainy times during the summer. The lagoon also receives some of the more liquid portion of the waste to reduce the volume that needs to be hauled to cropland. Mr. Gehlbach feels that this waste handling program is the most economical and acceptable method of disposal today. (Merryman-East Central)

2444-A2,A4,B2,B4,E2,F1

### MY WASTE-HANDLING SYSTEM FOR BEEF,

Beef producer, Elgin, Illinois
K. H. Bartels
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. L1

Descriptors: Agricultural runoff, Water pollution, Feedlots, Cost sharing.
Identifiers: Holding pond.

The report discussed the correction of a feedlot wastes runoff problem. Runoff was going directly into a drainage ditch approximately 100 feet from the feedlot. With the aid of the Soil Conservation Service a waste control plan was devised. The only equipment changed for the waste handling procedure was a pump and irrigation equipment for dispensing water from the holding pond. The approximate completion cost of the project will be about $3,200 (excluding pump and equipment), but cost-sharing was utilized. The runoff now no longer pollutes the creek and the area below the feedlot is much cleaner. (Penrod-East Central)

2445-B2, B4, E2, F1

### MY WASTE-HANDLING SYSTEM FOR DAIRY,

Dairy producer, Paris, Illinois
H. Boland
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, p. M1-M2.

Descriptors: Waste storage, Waste disposal, Liquid wastes, Dairy industry, Design, Costs, Cost sharing.

Due to a road building program along his property line, in 1971 Mr. Boland changed his waste handling practices to a liquid manure system. Extensive changes were required. A 105,000 gallon storage tank for the milking barn was installed beneath a 24' x 30' slatted floor and a 24' x 40' solid floor with three drag holes. A 1,000-gallon septic tank servicing the milk house and milking parlor was connected to a drain line to the storage tank and a manure pump was installed to automatically pump waste water into the storage tank. The storage tank is emptied by using a PTO-operated manure pump and a 1,500-gallon liquid spreader. The wastes are spread on fields that are not rolling or close to an open stream. The spreading area is approximately one-fourth mile from any residence. Help from the SCS, the Cooperative Extension Service, the University of Illinois, and the ASC office was acknowledged. Aid was received under the REAP Program. Cost was briefly discussed. (Penrod-East Central)

2446-A2,A4,A6,B2,B3,D3,E1,
E2

### LIVESTOCK WASTE MANAGEMENT IN A QUALITY ENVIRONMENT,

Extension Agricultural Engineer, Cooperative Extension Service, Illinois University, Urbana-Champaign
D. G. Jedele, Editor
Presented at Proceedings of 1973 Livestock Waste Management Conference, Champaign, Illinois, March 7-8, 1973, Circular 1074, p. 1-15. 8 fig, 1 tab.

Descriptors: Feedlots, Livestock, Agricultural runoff, Liquid wastes, Lagoons, Confinement pens, Solid wastes.
Identifiers: Waste management, Hauling, Gutter flushing, Oxidation ditch, Odor control, Dead animal disposal.

This circular was prepared to assist the livestock producer in assessing the pollution potential of livestock operations and to provide a systematic approach to resolving problems. The circular does not incorporate extensive technical data on buildings, manure collection and handling facilities, or equipment. It does delineate the parts of a waste management system, listing alternatives that may be used. Systems for reducing water pollution are described including: (1) Feedlot runoff control for unrestricted space, (2) Feedlot runoff control for restricted space, (3) Liquid manure system- hauling, (4) Liquid manure system—lagooning, (5) Liquid manure system—hauling and lagooning, (6) Gutter flushing in a confinement building, (7) Oxidation ditch in a confinement building and (8) Solid and liquid system for dairy facilities. Suggestions are given for reducing odor. Options for dead animal disposal are discussed. (Merryman-East Central)

2447-A2,A5,A8,B1,B2,C2

### SOIL WATER NITRATE BENEATH A BROAD-BASIN TERRACED FEEDLOTS,

U. S. Department of Agriculture, Nebraska University, Lincoln
L. F. Elliott, T. M. McCalla, N. P. Swanson, L. N. Mielke, T. A. Travis
Transactions of the ASAE, Vol. 16, No. 2, p. 285-286 293, March-April, 1973. 10 ref.

Descriptors: Soil water, Nitrates, Feedlots, Agricultural runoff, Nebraska, Denitrification.
Identifiers: Broad-basin terraced feedlot.

Nitrate accumulations occur beneath some feedlots but not others. Some recent studies indicate the possible role of management in nitrate accumulation beneath feedlots. More recent reports indicate continuous stocking of feedlots may preclude nitrate accumulations beneath them. Further investigation is warranted as runoff-control systems may complicate the situation. Swanson (1973) described a broad-basin terrace system that meets Nebraska runoff-regulatory requirements. The objective of this study was to determine if excessive nitrate accumulations in the feedlot soil profile would be caused by this system. Initiated in an 8-month-old, broad-basin terraced feedlot, caisson studies showed that soil water nitrate values rose initially. When the study was terminated, after 13 months, $NO_3$-N at 2, 4, and 5 ft. was 1.4, 10, and 12.5 ppm, respectively. Oxygen decreased and $CO_2$ increased during the latter part of the test period, indicating reducing conditions were occurring. The establishment of reducing conditions and the decrease in nitrate are indications of denitrification. Test results indicated that nitrate did not percolate below 5 ft. (Penrod-East Central)

2448-A8, B2, D1, D2, E2

### TRANSFORMATION, MOVEMENT, AND DISPOSAL OF NITROGEN FROM ANIMAL MANURE WASTES APPLIED TO SOILS,

B. L. Carlile
Unpublished Ph.D. Dissertation, Washington State University, Pullman, 1972, 70 p. 7 fig, 14 tab, 59 ref..

Descriptors: Nitrogen, Slurries, denitrification, Temperature, Carbon.
Identifiers: Land application, Anaerobic filters.

The objectives of this investigation were: (1) the determination of the transformation, movement, and disposal of nitrogen from animal manure wastes applied as a slurry at various rates to soils; and (2) the evaluation of the effectiveness of anaerobic filters for denitrification of nitrate-rich water. Soils receiving lower rates of manure applications had a greater initial rate of nitrification than did those receiving the highest rates, probably because of the ammonium inhibition of nitrifiers at higher manure application rates. Unless some measures for removing nitrates from the drainage water were implemented, all manure treatments resulted in nitrate concentrations sufficiently high to become a potential pollution hazard. The anaerobic filter may be practical for "on farm" treatment of soil drainage waters as it was shown to be effective for removing nitrate from nitrate-rich waters through the denitrification process. Using methanol as the source of carbon, nitrogen removal efficiencies of over 90 per cent were achieved at hydraulic detention times of under one hour in the treatment filter. In order to achieve satisfactory nitrogen removal, a readily biodegradable source of carbon must be added along with the soluble manure components. Milk was found to be such a source. With a reduction in temperature, no clear pattern of changes in nitrate removal efficiencies was observed, but when milk was utilized as the sole energy source, nitrate removal efficiency appeared to have been increased at lower temperatures. (Penrod-East Central)

2449-B2, B3, D1, E3, F1

### ENHANCED TREATMENT OF LIVESTOCK WASTEWATER. I. SOLID-LIQUID SEPARATION--ESTIMATION OF VIBRATORY SCREEN PERFORMANCES ON SWINE WASTEWATER,

Agricultural Pollution Control Laboratory, Department of Agricultural Engineering, Michigan State University, East Lansing 48823
P. O. Ngoddy, J. P. Harper, and J. B. Gerrish
Journal of Agricultural Engineering Research, Vol. 19, p. 313-328, 1974.

Descriptors: Waste water treatment, Separation techniques, Livestock, Dimensional analysis, Costs, Screens.
Identifiers: Swine.

The number of experimental studies on performance evaluation of a variety of sludge de-watering devices for solid-liquid separation of livestock wastes is increasing. The promise of minimizing capital investment costs on livestock wastewater management systems by substantially reducing the total bulk of water polluted and subsequently stored and-or processed is offered by the recycling of reclaimed wastewater. This study examines the vibrating screen separator for solid-liquid separation of livestock wastewater. Dimensional analysis is used as a rational basis for quantitatively evaluating the vibratory screen performance. Tests were run on swine waste-water and on one type of vibrating screen machine—the kind which derives its basic vibrational motion from the interaction of suspension drive springs and rotating weights driven at known angular velocity. Graphs of optimization plots (swine wastewater) and performance curves for swine wastewater are given. Tables are provided on the variables affecting the performance of vibrating screen separator, on sieve analysis and the removal percentage estimates of swine wastewater solids and on the results of vibrating screen separator test on swine wastewater. (Kehl-East Central)

2450-B1,B5,C2,D3,E3,F1

### ANAEROBIC DIGESTION OF HOG WASTES

Iowa State University, Ames, Iowa
E. P. Taiganides, E. R. Bauman, H. P. Johnson, and T. E. Hazen
Journal of Agricultural Engineering Research, Vol. 8, No. 4, p. 327-333, 1963. 5 fig, 9 ref.

Descriptors: Anaerobic digestion, Design, Hogs, Temperature, Methane, Nitrogen, Costs.
Identifiers: Liquefaction, Gasification.

The anaerobic sludge digestion process was evaluated and the results of a laboratory study on the application of sludge digestion for the treatment of swine wastes was reported. Several advantages and limitations of the digester process were discussed. The process can be carried out within a wide range of temperatures, provided that the temperature is maintained at a constant level. The rate of digestion increases with temperature from 32 to 104 degrees F, though the nature of the process changes and evolution of methane is much less at the lower and upper limit of the range. Two phases of decomposition occur in the digestion of organic matter: the liquefaction stage and the gasification stage. Results revealed that the fertilizer value of manure as measured by the nitrogen content was increased through digestion. The organic matter of the raw manure and, thus, its potential pollutional strength was reduced by 60-70 per cent through digestion. Considerations for the design of a digester were discussed. Although the initial investment for a digester is high, profit may be realized by operations producing over 10,000 hogs per year through the utilization of the excess combustible gas produced during digestion of the wastes. (Cameron-East Central)

2451-A4,B1,C2,C3,E1,F2

### LIVESTOCK FEEDLOTS ARE POLLUTION SOURCE,

Health Officer, Lyon County, Minnesota
P. Bosley
Medical Bulletin of the University of Minnesota, p. 3-6, March-April, 1971. 2 fig.

Descriptors: Feedlots, Water pollution, Minnesota, Biochemical oxygen demand, Nitrates, Sewage, Coliforms.

The discharge of animal and human waste into Minnesota lakes and rivers is a serious pollution hazard. Many farmers have dug a direct connection to rivers, streams, and lakes, piled excess manure on the edge of lakes, allowed their animals to defecate on frozen lakes, and left dead animals on riverbanks and in lakes. Several reports indicate that those practices are health hazards. Lake Yankton is used as a cesspool for the community of Balaton. County ditches, which collect wastes and run into rivers, are ubiquitous. County Ditch 29 had a massive B Coli count, and a toxic nitrate level of 17 at its start. The Minnesota Pollution Control Agency (PCA) is taking no action on this, and has forgotten the January, 1971, deadline imposed on the community of Ruthton to submit detailed plans for a sewage treatment system. The Redwood River (before the community of Marshall with a population of 10,000 empties its untreated sewage into it) has a B Coli count of 110,000 per 100 ml, while the accepted norm is 1,000 per ml. The BOD is over 30. Enforcement of regulations must be stricter, farmers must improve their feedlots, and sewage treatment facilities must be built. (Solid Waste Information Retrieval System)

2452-A11,A13,B1,C2,E3,F3

### RECYCLING ANIMAL WASTES,

Department of Animal Science, Iowa State University
K. C. Moellers and R. L. Vetter
The Iowa State University Veterinarian, Vol. 36, No. 3, p.88-90,92-94 1974.

Descriptors: Recycling, Farm wastes, Poultry, Cattle, Feeds, Nitrogen, Phosphorus, Potassium.
Identifiers: Swine, Composition.

The field of recycling animal wastes has become alive in the last five years. The main advantage of recycling would be the potential conservation of nitrogen, phosphorus, and essential mineral elements. Recycled wastes would be of limited value as an energy source; however, they may be of some value in a situation of roughage replacement. Dehydrated poultry waste can be used in rations for laying hens at levels up to 25 per cent of the total diet without decreasing egg production. There are many different processing methods being developed to improve cattle wastes as a feed. It has been demonstrated that cattle will readily consume processed manure up to 40 per cent of a basal ration. Dried swine feces have been added to swine diets up to 15 per cent while sustaining performance. Among present disadvantages in refeeding of wastes are the following: (1) inability to make content of wastes consistent, (2) need for research concerning disease transmission through refeeding of wastes, (3) need for more research concerning toxicological and drug residue problems associated with refeeding, and (4) aesthetics. It is hoped that with further research and experience, recycling of wastes will prove to be of economic value. (Cameron-East Central)

### 2453-A1, B1, F2

## AGRICULTURAL WASTES IN ARID ZONES,

Department of Civil Engineering, New Mexico State University, University Park
J. W. Hernandez
Health Related Problems in Arid Lands, American Association for the Advancement of Science Committee on Desert and Arid Zone Research Symposium, Arizona State University, Tempe, April 21-24, 1971, p. 37-43. 1 tab, 8 ref.

Descriptors: Farm wastes, Domestic wastes, Water pollution sources, Water quality, Consumptive use, Economic efficiency, Environmental effects, Waste water (Pollution), Ethics, Agriculture, Drainage water, Irrigation water, Arid lands, Return flow, Feedlots, Cattle, Poisons, Economics, Political aspects, Social aspects, Irrigation practices, Pesticides.

Three current agricultural waste disposal problems are common to much of the arid and semiarid regions of the United States, namely, return flows from irrigation, cattle feed-lot wastes and economic poisons. Characteristics of each are given and discussed. Regulation of existing irrigation projects by the imposition of water quality standards is unlikely in arid regions. As long as the attitude prevails that unused water is wasted and that it is in the national interest to make arid lands productive through irrigation, there will be continued pressure to import additional water supplies for arid-land irrigation. (Black-Arizona)

### 2454-A11,B1,D2,D3,E2,E3,F1

## WHY WASTE ANIMAL WASTES?

American Beef Producer, November, 1971, p. 10-11. 1 fig.

Descriptors: Waste disposal, Recycling, Lagoons.
Identifiers: Animal wastes, Ecolite, Aerobic digestion, Oxidation ditch, Composting, Building materials.

Disposing of animal waste is a problem which is being tackled anew each day by agricultural scientists John D. Mackenzie, University of California, developed Ecolite, a combination of treated cow dung (made by putting feedlot manure through a high temperature kiln) and melted glass. In addition to being lightweight, Ecolite is versatile and can be made into blocks, boards, panels, tiles or shingles. It can even be used as an air or water filter. In Iowa, cow dung is being recycled and refed to steers. Effluent is circulated beneath slotted floors in an oxidation ditch. Oxygen and water are added for "aerobic digestion", or breakdown. Tests indicate there are no DES or antibiotic residues. Test animals averaged 3.42 pounds gain per day while the control steers gained 3.36 pounds. Cost of gain was 22 cents a pound. Lagoons where wastes are dumped to allow aerobic decomposition provide another method of disposal. Composting reduces raw organic material to a loose workable, odorless nutritive soil additive. (Cameron-East Central)

### 2455-A5, A8, C2, E2

## CHEMICAL CHARACTERISTICS OF SOIL PERCOLATES FROM LYSIMETERS TREATED WITH MANURE,

D. G. S. Bielby
M. S. Thesis, University of Guelph, 1970, 123 p. 5 fig, 16 tab.

Descriptors: Chemical properties, Percolation, Lysimeters, Nutrients, Soil profiles, Nitrogen, Phosphorus, Potassium.
Identifiers: Groundwater pollution, Corn.

An attempt was made to establish the qualitative and quantitative contributions of different rates of manure to ground water contamination. A lysimeter study was conducted from February, 1968 to September, 1969. Specific objectives were: (1) To evaluate the lysimeters used in this study of nutrient percolation through a natural soil profile. (2) To determine the effects of high rates of liquid manure on a Guelph loam growing corn as a cover crop. (3) To determine the effects on groundwater quality of different rates of manure applied to a Guelph loam. (4) To account for the nitrogen applied in the manure. The following conclusions were drawn: (1) The natural soil profile lysimeters were adequate for obtaining leachate samples. On a seasonal basis, there was no difference in the volume of percolates between treatments. (2) The experimental design was not adequate to detect significant treatment differences when total nitrogen was measured. (3) Before fall data was included, 81.8 to 87.8 per cent of the added nitrogen could not be accounted for. When the October and November, 1969, data was added, the per cent of the added nitrogen not recovered was 38.3 to 61.5. (4) At least 20 per cent of the added nitrogen was in nitrate form and was leached out of the lysimeters by the flushing treatment. (5) Although corn has a high nutrient requirement, the period during which the plant takes up nutrients doesn't coincide with nitrogen movement downward and into the groundwater. Either some other crop should be grown to intercept the nitrogen moving into the groundwater during the spring and fall; or, the manure should be applied nearer to the time of maximum uptake by the corn. (6) Addition of manurial phosphorus and manurial potassium to the soil had very little effect on levels in the soil percolates. (Merryman-East Central)

### 2456-A10, B1, B5

## WINTER INOCULATIVE RELEASES OF PARASITOIDS TO REDUCE HOUSEFLIES IN POULTRY MANURE,

Division of Biological Control, Department of Entomology, California University, Riverside 92502
G. S. Olton and E. F. Legner
Journal of Economic Entomology, Vol. 68, No. 1, p. 35-38, February 17, 1975. 4 tab, 6 ref.

Descriptors: Vectors, Winter, Pest control, Temperature.
Identifiers: Poultry, Parasitoids, Houseflies.

The objective of this study was to determine the effectiveness of parasitoids on the reduction of houseflies in poultry manure. A poultry ranch was selected in the interior area of southern California for periodic inoculative releases of fly parasitoids to evaluate their colonization and relative activity on winter fly populations. The study was conducted during the period, December-April, 1969-1970. Three parasitoids were used: Tachinaephagus zealandicus Ashmead, Sphalangia endius Walker, and Muscicifurax raptor Girault and Sanders. M. domestica parasitization increased from a low of 3 per cent in January to a high of 46 per cent by mid-April. When host densities were increasing in later March and April, Fannia spp. parasitization increased to 16 per cent. The apparent superiority of T. zealandicus activity during colder weather may be related to the innate preferences of this parasitoid for lower temperatures and to the increases in the developmental time of the hosts, making them available for a longer period of time. These conditions favor both a numerical and functional response of the parasitoids. (Penrod-East Central)

### 2457-B3,D1,D2,D3,E2,E3,E4

## PROCEEDING OF SYMPOSIUM ON THE CONVERSION OF POULTRY WASTE TO ENERGY, FEED, OR FERTILIZER,

Pennsylvania State University
Proceedings of Symposium on the Conversion of Poultry Waste to Energy, Feed, or Fertilizer, Pennsylvania State University, November 6, 1974, 32 p. 2 fig, 1 tab, 90 ref.

Descriptors: Poultry, Solid wastes, Energy, Feeds, Fertilizers.
Identifiers: Conversion, Manure.

This symposium is devoted to the exploration of successful methods of converting solid poultry waste into energy, feed or fertilizer. When converted through chemical, physical, biological or aesthetic processes, this by-product can become useful, marketable, or harmless to us or our environment. The most common use of poultry manure is in land spreading and as a fertilizer. (Cameron-East Central)

### 2458-A6,B3,C1,D1,D2,F1

## THE MECHANICS OF AIR DRYING,

Instructor and Assistant Manager, Penn State Poultry Operation.
T. Burr
Proceedings of Symposium on the Conversion of Poultry Waste to Energy, Feed, or Fertilizer, Pennsylvania State University, November 6, 1974, p. 1-3.

Descriptors: Poultry, Moisture content, Costs, Dehydration, Aerobic conditions, Anaerobic conditions, Ventilation, Waste treatment.
Identifiers: Air drying, Agitation, Manure.

Researchers at Penn State are trying to solve the problem of handling poultry waste by utilizing the ventilation in the poultry house and body heat from the birds to dry the manure and then take this product and run it through a commercial dehydrator. In order to prevent anaerobic bacterial action and thus decrease odors, the manure must be dried from its 70-80 per cent moisture level to under 10 per cent moisture. The Sloping Wire Floor System, developed by Penn State for housing birds, lent itself readily to inhouse manure drying. The first step in manure drying was agitation of the manure to keep it in an aerobic state. Penn State built their own manure rakes, using the spike-toothed harrow arrangement as a manure rake. Together with agitation, air movement over the exposed surface of the manure is necessary to remove moisture. House ventilation is also very important for drying poultry manure. Electric heat cables were installed in the concrete floors beneath the manure. This aided in the drying of the manure but the cost was prohibitive. In stage-one drying system, the moisture content is reduced from 75-80 per cent to 25-30 per cent moisture and the cost would be $17.16 per ton. The stage-two drying system reduced moisture content from 25-30 per cent moisture to 10 per cent moisture and it cost $23.11 per ton. (Cameron-East Central)

### 2459-D2, D3, E3

## FERMENTATION AS A FEED PRODUCTION METHOD,

Poultry Science Extension, Pennsylvania State University
O. D. Keene
Proceedings of Symposium on the Conversion of Poultry Waste to Energy, Feed, or Fertilizer, Pennsylvania State University, November 6, 1974, p. 4-8. 14 ref.

Descriptors: Fermentation, Feeds, Recycling, Bacteria, Algae, Yeasts, Proteins, Cellulose.
Identifiers: Feed ingredients, Animal wastes, Hydrocarbons, Single cell protein, Conversion.

Fermentation has potential in producing food for man and animals. Research is now generally geared to study microbial fermentation on industrial wastes which contain organic compounds such as acetic acid, butanols, acetaldehyde, etc. Converting hydrocarbon wastes to single cell protein has been done with yeasts, bacteria and algae. These microorganisms have potential as animal feed ingredients. Ruminants utilize cellulosic wastes by rumen fermentation where microorganisms convert carbohydrates to microbial proteins, fatty acids, $CO_2$ and $CH_4$. Low quality cellulosic wastes have to be changed if they are to be used as feed ingredients. Anaerobic fermentation systems are usually less expensive than aerobic systems because oxygen doesn't have to be pumped into the system. Systems utilizing yeasts, bacteria, or algae all appear to have some promise in converting animal waste into feed ingredients particularly for single stomached animals. (Cameron-East Central)

## 2460-A11, B3, C2, E3, F1

### MARKETING CONVERTED MANURE,

Pennfield Farms Inc., Ephrata, Pennsylvania
G. H. Herr
Proceedings of Symposium on the Conversion of Poultry Waste to Energy, Feed, or Fertilizer, Pennsylvania State University, November 6, 1974, p. 9-12.

Descriptors: Marketing, Fertilizers, Feeds, Costs, California, Iowa, Legal aspects, Nutrients.
Identifiers: Dried poultry waste, Anaphage, Shud, Food and Drug Administration.

The author feels that the prime areas for marketing the finished dried poultry waste product is in the fertilizer and feed industries. The author states that the feeding opportunities have the most potential and that every day's delay of approval in F.D.A. is a crime and a waste of beneficial resource that should be helping us fight the battle of feed price inflation and world wide starvation. All tests of manure as a feed ingredient have been favorable to date. Many different people are testing samples of DPW. From some of the tests conducted in ruminant animals, it would appear that "quality DPW" should carry a value of two-thirds that of soy meal or 70 per cent that of corn. The protein in DPW is about 60 per cent uric acid and it takes a ruminant to convert this to energy and meat. Some tests showed results that veterinary bills were cut 50 per cent in a feedlot situation. Proper dehydration and fair marketing or usage could add conservatively 50-60 cents additional income per layer. There is an opportunity here to help solve two problems—environment and starvation—while the possibility exists to also turn a profit. (Cameron-East Central)

## 2461-A8, B3, C1, C2, E2

### BROILER LITTER FOR CROP PRODUCTION,

Extension Agronomist, Delaware University
W. H. Mitchell
Proceedings of Symposium on the Conversion of Poultry Waste to Energy, Feed, or Fertilizer, Pennsylvania State University, November 6, 1974, p. 13-16. 2 fig, 1 tab, 2 ref.

Descriptors: Poultry, Fertilizers, Costs, Crop production, Delaware.
Identifiers: Broiler litter, Application rates.

Large amounts of poultry litter are available in areas of the Delmarva Peninsula. On the average, the moisture content of the manure will be about 25 per cent but may range from 10-60 per cent. Litter produced in Delaware also contains about 2 per cent nitrogen, phosphorus and potassium and important amounts of micronutrients. Assuming current fertilizer prices, each ton of broiler litter would contain $N$-$P_2O_5$-$K_2O$ worth $23.20. Current fertilizer economics have stimulated a renewed interest in the product for crop production purposes. The best corn yields are obtained when broiler litter is applied at relatively low rates. Several tests are underway involving possible uses for the solid waste-poultry manure product. These include soil modification utilizing chiseling and the deep placement of broiler litter. (Cameron-East Central)

## 2462-B1,C1,C2,D3,E3,F1

### PRODUCTION OF METHANE FROM POULTRY MANURE,

Poultry Science Extension, Pennsylvania State University
H. C. Jordon
Proceedings of Symposium on the Conversion of Poultry Waste to Energy, Feed, or Fertilizer, Pennsylvania State University, November 6, 1974, p. 17-25.

Descriptors: Methane, Research and development, Chemical properties, Physical properties, Economics.
Identifiers: Production, Poultry manure, Digester.

Few managers have been successful at using poultry manure to generate methane. The methods need more research and field testing. This paper is a collection of what has been published by others and should be used as a guide to begin a discovery in methane production. The different items discussed in this paper are (1) properties of methane, (2) conditions inside the digester, (3) methods and management, (4) physical data, (5) chemical data, and (6) economics. (Cameron-East Central)

## 2463-B2, E2, E3, F1, F2

### BEEF IN CONFINEMENT WORKSHOP,

National Feed Ingredients Association
Beef in Confinement Workshop, National Feed Ingredients Association, Des Moines, Iowa, April 4, 1974, 60 p.

Descriptors: Feedlots, Confinement pens, Cattle, Legal aspects, Design, Costs, Recycling.
Identifiers: Waste management, Pollution control, Deep pit system, Flush flume system, Refeeding.

Legislation has made proper design and management of feedlots a must. Various aspects of beef confinement and waste management were considered in this workshop. Particular attention was given to operation design, costs, and performance. The deep pit system and the flush flume system were considered in detail. The value of recycling and refeeding was also discussed. (Cartmell-East Central)

## 2464-A6,A11,B2,C2,D3,E2

### OUR DEEP PIT SYSTEM,

Pampered Beef Aurelia, Iowa
R. Bryant
Beef in Confinement Workshop, National Feed Ingredients Association, Des Moines, Iowa, April 4, 1974, p.6-8, 1 fig.

Descriptors: Confinement pens, Costs, Cattle, Lagoons, Water pollution control, Odor, Ammonia, Performance.
Identifiers: Waste management, Land disposal, Deep pit system, Scrapers.

Dr. Bryant's presentation describes livestock operations in several states, which basically use similar waste management methods for handling cattle manure. A typical system utilizes 3' deep pits beneath slatted floors. These wastes are removed by a scraper system and stored in aerobic lagoons. The manure is then pumped for irrigation of nearby farmland. The scraper system shuts down each year during the 3-4 months of cold weather, but the storage capacity of the pits is designed to handle the waste load during these months. Then as the spring thaw begins, the scraping starts again. It is important to get the manure out from under the cattle during warm weather because ammonia coming up out of the pits has a direct relationship on performance. (Cartmell-East Central)

## 2465-A6,A11,B2,E1,E2,F1

### NEW FLUSH FLUME SYSTEM WITH DEEP LAGOON,

Estherville, Iowa
J. Greig
Beef in Confinement Workshop, National Feed Ingredients Association, Des Moines, Iowa, April 4, 1974, p. 9-13. 1 fig.

Descriptors: Lagoons, Odor, Feedlots, Confinement pens, Performance, Costs, Irrigation, Water requirement.
Identifiers: Flush flume system, Pollution control, Wind position.

This flush flume system is a mile and a half from town and not in a very good wind position. Because of this it would have presented a problem if the manure was spread on top of the ground. The building is a conventional type confinement and a pollution control structure was installed to catch the runoff water from the outside lots. There is about twenty feet of fall from the creek to a hill where the feedlot sits, and it all drains toward a settling basin and lagoon lot. The water holding capacity is an advantage because in the flush system you have a high water requirement. The advantages of this waste management system are that the cattle are not wet, there hasn't been any trouble with the cattle slipping, and the cost of the entire operation is $80 per head. The only real disadvantage is the problem of steam. (Cartmell-East Central)

## 2466-A6, B1, B2, F1

### HOW CONFINEMENT FEEDING CAN BE SIMPLE AND EFFECTIVE,

Cattle Feeder—Engineer, Fairfield, Nebraska
R. Kissinger, Jr.
Beef in Confinement Workshop, National Feed Ingredients Association, Des Moines, Iowa, April 4, 1974, p. 16-19. 1 fig.

Descriptors: Confinement pens, Design, Cattle, Ventilation, Temperature, Humidity, Construction, Costs, Flume, Odor, Water requirement.
Identifiers: Flushing, Slats.

This confinement building is 510 ft. x 52 ft. with a feeding area width of 37 ft. 10 inches. There are six pens graduated in size with a total capacity of 1,110 steers at an average weight of 950 lb. Alternate 10 ft. bays on the north side are sliding doors to provide ventilation in the summer. There is a gate on the south side of each pen for removal of any sick cattle. New cattle are loaded through this gate in the east end and fat cattle are shipped from the west end. The ridge opening is 12 inches; a lesser width might lead to difficulty under certain temperature and humidity conditions. In order to reduce construction costs and to utilize the flushing concept without installing dividing walls in a deep pit, a series of inclined cement slabs were used in conjunction with two longitudinal 8 foot wide pits with slats. The anaerobic lagoon is 200 ft. x 200 ft. x 30 ft. maximum depth and holds about 3.5 million gallons of liquid. The mat on the surface varies from zero to four or five feet thick. It is helpful in reducing odors. Flushing is accomplished by throwing a switch. The pit slope varies from 25 per cent to .4 per cent and works quite well. (Cartmell-East Central)

## 2467-A4, B1, F2

### LEGAL ASPECTS OF WASTE POLLUTION LAWS,

Kansas Livestock Association Topeka, Kansas
V. Huseman
Beef in Confinement Workshop, National Feed Ingredients Association, Des Moines, Iowa, April 4, 1974, p. 27-29. 1 fig.

Descriptors: Legal aspects, Feedlots, Water pollution.
Identifiers: Water Pollution Control Act Amendments of 1972, Zero discharge, Environmental Protection Agency.

The 92nd Congress has passed a Public Law 92-500, better known as the Water Pollution Control Act Amendments of 1972. This represented the first time that the Federal Government got into the business of regulating feedlots as they relate to the environment. Feedlots are specifically defined in the act as a "point sources" of water pollution. The Federal Water Pollution Control Act Amendments made some unprecedented demands on the livestock industry. It states ". . . it is the national goal that the discharge of pollutants into navigable water be eliminated by 1985". That section seems to imply zero discharge. It is impossible to guarantee zero discharge. The Environmental Protection Agency has not developed a set of rules or guidelines for the disposal of wastes, except to recognize that application on agricultural land appears to be the most practical method. The Environmental Protection Agency recommends that operators fill out a Short Form B so that they will be on record with them. (Cartmell-East Central)

### 2468-A11,A12,B1,C2,E3

## RECYCLING, ITS PROBLEM AND OPPORTUNITIES,

Iowa State University, Ames
R. Vetter
Beef In Confinement Workshop, National Feed Ingredients Association, Des Moines, Iowa, April 4, 1974, p. 30-35. 1 fig, 7 tab, 9 ref.

Descriptors: Recycling, Methane, Lagoons, Nutrients, Proteins, Confinement pens, Safety.
Identifiers: Refeeding, Health, Food and Drug Administration

The objective of this review was to relate some of the technologies developed in the area of recycling and to discuss the nutritive value or quality of animal excretory wastes as supplemental nutrients. It is only under conditions where the animals are housed in confined or semiconfined areas that excreta can be effectively utilized for refeeding. The advantages of refeeding lie in the potential conservation of nitrogen, phosphorus and essential mineral elements. As an energy source excreta is of limited value for finishing cattle except for roughage substitution, in which case considerable processing is needed. A disadvantage of refeeding is that variation in waste handling conditions and nutrient content would make ration control difficult. The author feels that smaller midwest farm feedlots will utilize confinement feeding and move in the direction of a total concept of conservation recycling, utilizing a natural harmony of animal, plant, soil, and microbial systems. (Cartmell-East Central)

### 2469-B1,B3,D1,D3,E2,E3

## ANIMAL WASTE HANDLING AND "CAN THE TAIL WAG THE DOG?",

President, Corral Industries, Phoenix, Arizona
R. E. Bunger
Beef in Confinement Workshop, National Feed Ingredients Association, Des Moines, Iowa, April 4, 1974, p. 40-50. 12 fig, 5 tab.

Descriptors: Costs, Feedlots, Fertilizers, Nutrients, Irrigation, Liquid wastes.
Identifiers: Waste handling, Refeeding, Closed Ecological Cycle, Composting, Land disposal.

Ten thousand head of 800-pound average weight cattle confined in a feedlot will produce 233,600,000 pounds of urine and feces yearly. The cost of removing manure from feed pens to a nearby stockpile will currently run to approximately $1.50 per wet ton under optimum operating conditions, and may run to considerably more in adverse weather conditions. A brief outline of the "Closed Ecological Cycle" under development by Corral Industries of Phoenix is shown. This test indicated a very substantial daily gain average for both groups of cattle—2.88 pounds per day for the control group, and 2.76 pounds per day for the treated (25 per cent recycled solids; 75 per cent grain) group. After the test was completed, the animals were killed and the carcasses were analyzed for grade and yield. The control group had a dressing percentage, or yield, of 60.8 per cent and the treated group had 60.6 per cent. This feed trial was extremely encouraging, and the results have proven the acceptability and efficacy of recycling high levels of recovered solids. It was estimated that this separation system would cost not over $125,000 for 10,000 head of cattle, and would require no more than $200 per day to operate. (Cartmell-East Central)

### 2470-B2,C1,C2,C3,D1,D3

## WASTE HANDLING AND LAGOON MANAGEMENT,

Minnesota University St. Paul
J. A. Moore
Beef in Confinement Workshop, National Feed Ingredients Association, Des Moines, Iowa, April 4, 1974, p. 51-55. 1 fig.

Descriptors: Lagoons, Feedlots, Design, Chemical properties, Physical properties, Biological properties.
Identifiers: Waste management.

Any beef operator who is considering expanding, redesigning, or rebuilding new facilities should have certain objectives in mind. It is important that these objectives be formalized and listed so that each proposed system can be evaluated as to its potential of successfully meeting the objectives. Considerations that should be evaluated include climate, weather, lot location, nearness to surface and groundwater, soil type and slope, animal numbers and density, pollution control regulations, and nearness to neighbors. Once the objectives of the system have been established, it is important to determine and calculate the properties and characteristics of the material to be handled. The properties and characteristics of animal waste can be broken down into three categories: physical, chemical, and biological. Those aspects of animal waste which may influence design include: collection, storage, treatment and utilization. Advantages and disadvantages are given for the following waste handling operations: liquid collection, storage lagoon, mechanical treatment, and biological treatment. There is no one best system for all operators. (Cartmell-East Central)

### 2471-A2, A6, B2, D3, E1

## MANURE DISPOSAL LAGOONS,

Agricultural Engineering Research Division, Agricultural Research Service, United States Department of Agriculture, College Park, Maryland
H. J. Eby
Bulletin ARS 42-75, Agricultural Research Service, United States Department of Agriculture, June, 1963, 12 p. 1 fig, 1 tab, 34 ref.

Descriptors: Waste disposal, Lagoons, Aerobic conditions, Anaerobic conditions, Design criteria.
Identifiers: Oxidation pond, Lagoon management, Stabilization pond.

The purpose of this study is to observe manure disposal lagoons in several Eastern and Midwestern States and in Canada and to review the available literature on the subject. There are three types of manure disposal lagoons: anaerobic, aerobic, or a combination of the two. The first type is an open pit or trench and is entirely anaerobic in action. The second type of manure lagoon is also known as an "oxidation pond". The third type of lagoon is referred to as a "stabilization pond" and it produces the least odor of the three types. Explanation is given as to how lagoons work. Factors that need to be considered in constructing a manure disposal lagoon are: (1) Availability of land; (2) Possibility of objectionable runoff that would degrade downstream water; (3) Choice between a stabilization pond or a true oxidation pond; and (4) Enough water being available to maintain the lagoon. Alternatives or modifications of the manure lagoon are discussed. For best results in lagoon management, the following procedures should be followed: (1) Floating material should not be permitted to enter the lagoon; (2) Lagoon loading should be regular and uniform; (3) Constant water depth should be maintained; (4) Weeds should be mowed around the edges of the lagoon; (5) The lagoons should be filled before running manures into it; (6) If algae mats form on the lagoon surface, the surface should be agitated; (7) Petroleum products or other floating products should not be allowed to enter the lagoon. (Penrod-East Central)

### 2472-B1, B2, B3, C1, C2, C3, D1, D3, E2, E3, F1

## MIDWEST LIVESTOCK WASTE MANAGEMENT CONFERENCE,

Iowa State University
Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 184 p. 31 fig, 24 tab, 125 ref.

Descriptors: Feedlots, Hydrology, Design, Confinement pens, Separation techniques, Anaerobic digestion, Methane, Aerobic treatment, Livestock, Costs.
Identifiers: Waste management, Flushing, Land spreading.

The purpose of the conference was to bring together all aspects of feedlot and animal waste management. Hydrology was discussed by several papers. The hydrologic characteristics of animal waste, design criteria for gutter flushing systems and recirculation equipment design were areas covered in the discussion. Three papers covered livestock waste treatment for both confinement pens and outdoor feedlots. Criteria for the selection of a treatment and handling system for wastes were given. Various building types for confinement housing and their manure handling systems were also discussed. Recommended management practices for the control of waste from outdoor, unpaved feedlots were examined. The effects of waste management systems on the animals involved were presented. Solids separation; aerobic treatment, and the anaerobic digestion of livestock wastes with methane production were discussed thoroughly. Land disposal was examined through the aspects of equipment considerations; agronomic considerations; and the pollution potential of liquid wastes. (Penrod-East Central)

### 2473-A2,A3,A5,B1,B2,C1,C2

## HYDROLOGY OF OPEN FEEDLOTS IN THE CORNBELT,

United States Department of Agriculture, Lincoln, Nebraska
N. P. Swanson
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 11p. 1 fig, 21 ref.

Descriptors: Hydrology, Feedlots, Corn Belt, Rainfall, Snow, Evaporation, Agricultural runoff, Snowmelt, Groundwater pollution.
Identifiers: Solids losses

The purpose of this study is to examine the hydrologic factors of open feedlots in the corn belt. The factors discussed are: temperature, snow, evaporation and rainfall. Since the hydrologic impact of feedlots is on the immediate watershed, hydrology should be considered in feedlot design and management. Rapid drainage of a feedlot is very desirable and is improved by the utilization of mounds and drainways, terraces and basins, and inlet risers with underground drains. Runoff control facilities should be designed for periods of probable high-intensity and maximum intensity precipitation without opportunity for runoff disposal. The study showed that underground water pollution from livestock feeding installations appears to be mostly a local problem with widespread contamination of aquifers not appearing probable. Runoff will be greater and start sooner from a feedlot than from adjacent cropland. There can be appreciable water storage in the soil-manure mixture. The study also indicated that snowmelt runoff may contain 10 to 12 times the chemical oxygen demand and solids content of a rainfall-runoff from the same lots. It was noted that similar runoff facility design capacities can be expected in the Corn Belt states, except in western Kansas, Nebraska, and South Dakota. (Penrod-East Central)

2474-B2, B3, B4, D3, E2

### CRITERIA FOR THE SELECTION OF A LIVESTOCK WASTE TREATMENT AND HANDLING SYSTEM,

Department of Agricultural Engineering, Illinois University, Urbana-Champaign
A. J. Muehling
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November, 27-28, 1973. 8 p.

Descriptors: Waste treatment, Waste disposal, Livestock, Confinement pens, Locating, Costs, Lagoons, Odor.
Identifiers: Solid floors, Slotted floors, Pit storage, Hauling, Flushing.

Numerous restricting federal and state regulations covering the treatment and handling of livestock wastes are being enacted. Selection and planning for the waste handling and treatment system must be an integral part of the planning for any confinement operation. This report provides criteria for the selection of a treatment and handling system for livestock waste. There are several factors to consider. Among them are: investment and operational costs; operation size; location of facility with regard to neighbors, the operator's family, soil type and topography; type of facility; existing facilities and equipment; and personal preference. The major systems presently being used are discussed examining the advantages and disadvantages of each. They are: (1) solid floors, manure handled as a solid, (2) slotted floors, pit storage, liquids hauled to the fields, (3) lagoons, (4) slotted floors, pit storage, manure hauled to the fields, an overflow lagoon, (5) slotted floors, a pit with an oxidation ditch and (6) flush system. A comparison table was developed and provided to help the producer rate the systems and decide which one is best suited to his operation. (Penrod-East Central)

2475-A2,B1,B2,B3,B4,E2

### OUTDOOR, UNPAVED FEEDLOT MANAGEMENT,

Agricultural Research Service, United States Department of Agriculture, Nebraska University, Lincoln
J. A. Nienaber and G. B. Gilbertson
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 19 p. 2 fig, 4 tab, 16 ref.

Descriptors: Feedlots, Design, Agricultural runoff, Drainage, Mud, Snowmelt, Irrigation.
Identifiers: Unpaved feedlots, Waste management, Holding pond, Debris basin, Mounding.

This report summarizes recommended management practices for control of waste from outdoor, unpaved feedlots. Area requirements for cattle, mound construction, and drainage are discussed in terms of basic requirements for satisfactory feedlot performance. Mud problems must also be considered in the design and management of the feedlot. The three basic components of a runoff control system are: holding pond, debris basin, and disposal area. Suggestions for the design and management of the feedlot, debris basin, holding pond and disposal area are given. Facilities should be planned which provide for a reduction of cattle density to 500 $ft^2$-head during winter operations. Mounds should be constructed parallel to the lot slope and should be connected with the feedbunk and waterer. A minimum of 1.25 ac-in-acre volume should be provided if overflow is collected by the holding pond. If the overflow cannot be collected by the holding pond, 70 per cent of the 10 year, 24-hour storm should be provided for. An excessive snowmelt should be anticipated every 2-3 years; although reduced cattle density will relieve the resulting muddy conditions. There should be a minimum holding pond storage volume of 100 per cent of the 10-year, 24-hour storm. An existing irrigation system should be used if possible; otherwise, the minimum area for liquid disposal is ½ acre of pasture per acre of feedlot. (Penrod-East Central)

2476-B2, B3, F4

### CONFINEMENT SYSTEMS AND MANURE MANAGEMENT: STATE OF THE ART

V. M. Meyer
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 10 p. 17 fig.

Descriptors: Confinement pens, Livestock, Design.
Identifiers: Waste management, Solid floors, Slotted floors, Stall barn, Free stall, Pits.

This report lists various building types and their manure handling systems for swine, beef, dairy, poultry, and sheep. The building types for swine were divided in three categories: farrowing, nursery and finishing. For farrowing, buildings housing solid floor with or without bedding, and slotted floor, both total and partial, were listed along with their manure handling systems. A similar setup was provided for the nursery. For finishing swine, outside concrete and cold and warm building were given with their systems. The building types listed for beef were solid and slotted floors. Dairy livestock buildings included stall barn and free stall. For poultry, three building types were listed: deep pit, liquid, and shallow pit. Sheep were listed only with solid building types. (Penrod-East Central)

2477-A6,A11,B1,C2,C3,D3

### EFFECTS OF WASTE MANAGEMENT SYSTEMS ON THE ANIMAL'S ENVIRONMENT,

Department of Agricultural Engineering, Nebraska University, Lincoln
J. A. DeShazer
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 5 p. 1 tab, 11 ref.

Descriptors: Confinement pens, Farm management, Waste storage, Ventilation, Odor, Humidity, Temperature, Hydrogen sulfide, Ammonia.
Identifiers: Waste removal, Aerobic pit, Anaerobic pit, Slotted floor.

A major concern of the livestock environmental engineer about waste handling techniques is how these systems affect the gaseous and bacterial environment of livestock. The objective of this study is to describe the effects of such techniques on the animal. Two systems under consideration are the storage of the waste within the building and the frequent removal of wastes from the building. A comparison of the hydrogen sulfide and ammonia concentrations of an open-front swine building and an enclosed swine building was made in the summer of 1971 at the University of Nebraska. Results showed that the level of both gases was approximately the same. A study of pit ventilation in swine confinement buildings versus side wall ventilation with no pit ventilation during the spring showed that there was no difference in hog performance. More sneezing and coughing occurred among pigs kept over anaerobic pits than among those kept over aerobic pits, according to a Purdue University study. Hog management for proper dunging habits is important in odor control of the hog's environment. The waste handling system can affect the thermal environment of the animals, with humidity probably being the major concern. The study showed that the performance of livestock seems not to be affected by either the treatment of waste within the building or frequent removal of waste from the building. (Penrod-East Central)

2478-B2, B3, C1, D1

### SOLIDS SEPARATION,

Department of Agricultural Engineering, Wisconsin University, Madison
R. E. Graves
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 8 p. 7 ref.

Descriptors: Separation techniques, Solid wastes, Slurries, Settling basin, Flotation, Centrifugation, Moisture content.
Identifiers: Screening, Settling pond, Vacuum filtration.

Manure and water slurries resulting from hydraulic cleaning or transport must be handled and-or treated. The solid material in such slurries ranges from dissolved salts and soluble organic matter to hair, feathers, unused feed, and stones. Since solids can be separated from manure and water slurries, this can be a useful step in an overall animal waste treatment system. Solids separation may be achieved through use of one of the following systems: settling, screens, vibrating screens, stationary sloping screens, other screens, flotation, centrifugation, and vacuum filtration. Each of these methods is explained. When using solids separation and concentration for waste handling and treatment systems, the livestock owner must keep in mind the cost, complexity, and the overall goal of the waste management system. (Penrod-East Central)

2479-D3, E3, F1

### ANAEROBIC DIGESTION OF LIVESTOCK WASTES AND THE PROSPECTS FOR METHANE PRODUCTION,

R. J. Smith
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28 1973, 30 p. 2 fig, 5 tab, 26 ref.

Descriptors: Anaerobic digestion, Livestock, Methane, Costs, Toxicity, Temperature.

This paper describes the processes involved in anaerobically digesting livestock wastes to produce methane. Anaerobic digestion of livestock wastes for methane production is technically quite feasible, but at present it is not economically feasible. Besides the high capital investment for the methane production itself (which is only a partial waste stabilization process), any realistic anaerobic digester must be followed by further processes of waste stabilization and these may be expensive, or they may consume power, thus reducing the amount available for sale. The author feels that a resurgence of interest in methane production will occur on the part of the utilities (as opposed to individual producers) if and when natural gas becomes a scarce commodity. It should then be possible to consider funding, using tax money since the gas production would have some aspects of social service. (Penrod-East Central)

### 2480-B2, D3
### AEROBIC TREATMENT OF LIVESTOCK WASTES,
Purdue University, Lafayette, Indiana
J. C. Nye
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 11 p. 2 tab, 2 ref.

Descriptors: Aerobic treatment, Livestock, Design, Organic acids, Nitrogen, Hydrogen sulfide, Oxidation reduction potential, pH.
Identifiers: Oxidation ditch, Mechanically aerated lagoon, Oxidation pond, Aerators.

The purpose of this report is to provide a brief description of design procedures for aerobic treatment facilities which can be used in consultations with individual livestock producers. Basically, there are three approaches to aerobic treatment. They are: (1) oxidation ditch, (2) mechanically aerated lagoon, and (3) oxidation pond. Each of these methods is discussed. A major problem with an aerobic treatment process is the breakdown or overloading of the aeration system. When this happens, the aerobic bacteria may have competition from other organisms which utilize other compounds in their metabolic processes. If the aeration equipment fails to operate and the aerobic process becomes anaerobic, the organisms will first use nitrate as an electron acceptor in their metabolism. Sulfate may also be utilized releasing hydrogen sulfide gas which can kill livestock. A final substitute for oxygen may be an organic compound which can result in methane production. The terminal product of the oxidation-reduction process is controlled by the ORP (Oxidation-Reduction Potential) of the liquid. This means that when aerators break down, it is important that they be repaired or replaced as soon as possible to prevent ORP from dropping to the level where odorous gases are given off. A shift in pH may also result during these anaerobic conditions from the production of organic acids. This shift may cause flaming when the aerators are restarted. A final decision on equipment should be based on availability of replacement parts and reliability. (Penrod-East Central)

### 2481-B2, B4, D3
### FLUSH GUTTER SYSTEMS--CURRENT IOWA INSTALLATIONS,
S. W. Melvin, J. C. Lorimor, D. O. Hull
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 10 p. 3 fig, 7 ref.

Descriptors: Iowa, Hydraulic systems, Anaerobic digestion, Lagoons, Confinement pens.
Identifiers: Flush gutter systems, Pits, Slotted floors, Flumes.

Several different types of hydraulic flush confinement beef buildings have been, or are being constructed in Iowa. Many questions concerning their operation remain unanswered. All of these systems are utilizing lagoons, for treatment and storage prior to recycling or disposal. Anaerobic lagoons could well be the limiting component of these systems. Only time will answer some of the questions concerning management and operation of each of these systems. Engineers will be required to develop some of these concepts even further as confinement feeding of beef cattle continues. (Melvin)

### 2482-B2, C1
### HYDRAULIC CHARACTERISTICS OF ANIMAL WASTE,
Department of Agricultural Engineering, Minnesota University, St. Paul
J. A. Moore
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 18 p. 2 fig, 2 tab, 24 ref.

Descriptors: Hydraulic systems, Animal wastes, Design, Moisture content, Viscosity, Pumping, Waste storage, Waste treatment.
Identifiers: Solids content, Flushing, Settling, Agitation, Collection, Utilization, Total solids.

Hydraulic characteristics must be considered when planning or managing an animal waste system. The four system components are collection, storage, treatment, and utilization. Not all of these components are included in every system. The purpose of this report is to examine the hydraulic characteristics of animal waste and their application to the engineering properties of materials as applied to designing and-or managing livestock wastes. Hydraulic characteristics discussed are: moisture content and its measurement, flushing, solids content and viscosity, settling, agitation, and pumping. In the measurement of moisture content, calculated total solids must be related to the fluid characteristics. Other factors besides particle size need to be considered in settling evaluation. They include precipitation, amount of solids and removal, and water-manure ratio. Study data indicate that as the quantity of waste hay, silage and green shop entering increases, agitation becomes more difficult. Hydraulic characteristics and many other factors combine to determine the design and management of a livestock waste system. (Penrod-East Central)

### 2483-A6, B2, D3, E2, F1
### DESIGNING GUTTER FLUSHING SYSTEMS,
Missouri University Columbia
R. M. George
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 14 p. 5 tab, 3 ref.

Descriptors: Design criteria, Hydraulic transportation, Missouri, Mannings Equation, Flow, Slope, Velocity.
Identifiers: Gutter flushing, Instant lagoon concept, Slats, Swine.

Gutter flushing systems seem to work well with the components of animal waste management systems using anaerobic lagooning and irrigation disposal of the effluent. Such systems have minimum odors, low cost, and the flushing is most consistent with good lagoon management. The purpose of this report is to provide parameters for designing gutter flushing systems. The report provides a procedure for designing open gutter and gutter under slats flushing systems for swine. The method also works well for Beef Slope-Slot Systems. A new variation of hydraulic transport called "Instant Lagoon Concept" is described. This concept says if .0027123 of the lagoon design volume is circulated daily through a smaller pit or basin, the biological activity would be the same if the same amount of manure were placed continuously in the larger lagoon. Supporting design data derived from operating Missouri systems are presented. The selection of design parameters is examined and the depth of flow, width of channel and hydraulic radius are discussed. Design philosophy and procedures are given. Some systems and their application are explained. (Penrod-East Central)

### 2484-B2, D3, E3
### RECIRCULATION EQUIPMENT DESIGN AND SELECTION,
Department of Agricultural Engineering, Iowa State University, Ames
G. B. Parker
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 7 p.

Descriptors: Equipment, Design, Hydraulic transportation, Recycling, Lagoons, Pumps.
Identifiers: Flushing, Channel design, Piping.

Large quantities of a relatively "clean" pumpable liquid are needed for hydraulic transport of animal wastes from a confinement system. Although the cost of great quantities of fresh water is high, the main problem is the hauling and disposal of the resultant contaminated liquor. The purpose of this study is to investigate recycling as a means of supplying the quantities of fluid required without increasing the volume of waste to be disposed of. So far only two economically feasible waste handling systems applicable to hydraulic transport have been developed. They are the aerobic lagoon or basin and the anaerobic lagoon. The anaerobic lagoon eliminates most of the solids because nearly all solids settle to the bottom where they are anaerobically digested at varying rates. However high chemical instability has been encountered as a significant problem with this system. In designing a hydraulic transport system, channel design, method of flushing, pipes, and the type of recycle pump to be used must be decided upon. The author's experience with various brands and models of pumps is given. (Penrod-East Central)

### 2485-A8, C2, E2
### AGRONOMIC CONSIDERATIONS OF ANIMAL WASTE DISPOSAL,
Extension Agronomist, Iowa State University, Ames
R. D. Voss
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 7 p. 5 ref.

Descriptors: Waste disposal, Agronomy, Crop response, Nitrogen, Phosphorus, Nutrients, Salts.
Identifiers: Land disposal.

In this paper the assumption is made that the soil's usefulness for crop production is to be maintained. The primary concern is if land disposal of animal wastes is the ultimate goal, how much can be applied without causing short or long term problems. Short term effects would include: salt and toxic effects on germination and growth of plants, loss of nitrate in drainage water, crop quality, crop yields, and surface runoff. Long term effects would include: crop productivity, accumulative salt effect on crops, dispersal of soils by accumulation of sodium, and nutrient imbalance due to phosphorus or other element buildup. Suggested optimum rates of application of animal wastes for efficient utilization of the nutrients by harvested crops are 10 to 20 tons per acre on a fresh weight basis according to several authorities. Plans for any animal waste handling system should include provision for waste disposal. The plans should be according to guidelines which, hopefully, will include agronomic considerations. (Penrod-East Central)

### 2486-A2, B2, C2, E2
### SUMMARY OF KANSAS' EXPERIENCE WITH LIQUID WASTE SPREADING,
Department of Agricultural Engineering and Agronomy, Kansas State University
H. L. Manges, L. S. Murphy, and W. L. Powers
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 9 p. 2 fig, 3 tab, 3 ref.

Descriptors: Kansas, Agricultural runoff, Lagoons, Fertilizers, Nutrients, Crop response, Salt tolerance, Chemical properties.
Identifiers: Land disposal, Guidelines.

The cattle feeders of Kansas are controlling surface water pollution by catching and storing feedlot runoff in lagoons. In Western Kansas, collected runoff is evaporated since evaporation greatly exceeds rainfall. Remaining feedlots resort to land disposal of the runoff. Since land application of runoff hasn't been practiced very much, little is known about application rates. The purpose of this report is to examine and determine the pollution potential from high application rates of feedlot wastes to land. The study showed that snowmelt runoff pollutants concentration is 2 to 2½ times that of rainfall. Runoff storage in lagoons results in pollutants concentration increasing with the evaporation of pure water. Recommendations for runoff analyses are given. If runoff is applied as a fertilizer it should be applied at rates necessary to supply the nutrients required by the crop growth. Fertilizer recommendation for the area could be used as one criteria. Guidelines and recommendations were given for feedlot runoff application onto land. Average annual application rates of 5, 5 and 9 inches in 1971, 1972, and 1973, respectively resulted in top corn forage yields in Kansas. Salt buildup in the soil will eventually determine application rates. (Penrod-East Central)

### 2487-B2, E2

### RETURNING ANIMAL WASTES TO THE LAND-EQUIPMENT CONSIDERATIONS,

Missouri University, Columbia
M. Peterson
Presented at Midwest Livestock Waste Management Conference, Iowa State University, Ames, November 27-28, 1973, 11 p. 2 fig, 2 tab.

Descriptors: Equipment, Design criteria, Pumps, Pipes, Irrigation, Slurries, Lagoons, Volume.
Identifiers: Land disposal, Consistency.

Large waste disposal and potential pollution problems are created by the concentration of livestock in small areas. The purpose of this report is to describe developments in animal waste systems including: collection, pumping, and distribution systems. The initial considerations of planning a livestock operation are location and good design and management. Design considerations include: (1) Volume of wastes produced, (2) Consistency of wastes, (3) Pump materials and seals, (4) Pumping unit controls, (5) Piping systems, and (6) Choosing an irrigation disposal system. Lagoon effluent, or other fluid wastes containing less than 5 per cent solids can be handled by most irrigation systems: ditches with spile tubes, gated pipe, hand-carry sprinkler systems, traveling gun systems, side-roll sprinkler systems and center pivot sprinklers. Liquid slurries, having up to 14 per cent solids, may be handled only by a hand carry gun sprinkler, liquid manure tankwagon, or a traveling gun sprinkler. Alternative ownership schemes for livestock producers reluctant to invest large amount of money in irrigation disposal equipment initially are provided. Management is the key to making a well-designed system work. (Penrod-East Central)

### 2488-A6, B2, D2, F2

### PERSONAL SIDELIGHTS AND OBSERVATIONS OF THE HBI TRIAL,

L. Harper
Missouri Ruralist, Vol. 110, No. 7, p. 38-39, April 12, 1969.

Descriptors: Odor, Lagoons, Zoning.
Identifiers: Lawsuits, Swine industry.

This report examines the Bower vs. Hog Builders Incorporated (HBI) trial and its impact on livestock producers. The plantiffs claimed that their lives had been made miserable either by intent or willful negligence on the part of HBI. The point was made that anaerobic lagoons were never intended to be waste disposal structures and that odor was a natural characteristic of anaerobic lagoons. An important question that the trial raised was: "Who does the livestock man turn to for advice and recommendations with some assurance of protection against a lawsuit?" Another point that needed to be clarified was whether or not a hog operation—even a large hog operation—can be classified as a heavy industry when zoning regulations are being applied. These and several other questions were brought out by the HBI trial which awarded the plaintiff's damages. This trial points to need for livestock producers to be aware of and to control pollution from their facilities so that environmental quality can be preserved and lawsuits can be avoided. (Penrod-East Central)

### 2489-A6, A11, B1

### PLANNING CONSIDERATIONS FOR CONFINEMENT SWINE FACILITIES,

Hog Product Manager, Big Dutchman, Zeeland, Michigan
B. Engle
Presented at the 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-919, 12 p. 4 fig, 4 tab.

Descriptors: Confinement pens, Planning, Design, Ventilation, Temperature.
Identifiers: Swine, Comfort zone.

The purpose of this report is to present management tools developed by Big Dutchman for commercial hog producers that may be utilized in planning hog facilities. The author stresses the necessity of having better managers in order to obtain the best results from facilities improved by technology. Since hogs are very sensitive to temperature, the facilities discussed are designed to maintain the temperature within the range of 50 degrees to 80 degrees. The major factor holding back acceptance of confinement facilities is poor ventilation. One difficulty in properly ventilating a building is that hogs do not all require the same temperature and air movement. Negative air systems are favored by the author and his company for maintaining the air patterns that provide oxygen, clean out foul air, promote good dunging habits, and keep temperature variations at a minimum. These systems are discussed. The various side issues to ventilation that affect environmental control are: pig brooding, type of penning, long narrow pens, comfort zone, per cent of slats, and evaporative cooling. Proper planning is essential in keeping labor at a minimum and in promoting proper production flow. Methods of grouping sows for breeding and continuous farrowing are examined. Clean up in the farrowing units is also discussed. A simple method of planning a hog facility so that expansion is possible by simply adding on necessary buildings is given. (Penrod-East Central)

### 2490-A8, C2, E2

### EFFECTS OF BEEF-FEEDLOT MANURE AND LAGOON WATER ON IRON, ZINC, MANGANESE AND COPPER CONTENT IN CORN AND IN DTPA SOIL EXTRACTS,

Departments of Agronomy and Agricultural Engineering, Kansas State University, Manhattan
G. W. Wallingford, L. S. Murphy, W. L. Powers, and H. L. Manges
Soil Science Society of America Proceedings, Vol. 39, No. 3, p. 482-487, May-June, 1975. 6 fig, 4 tab, 25 ref.

Descriptors: Feedlots, Cattle, Crop response, Copper, Iron, Zinc, Manganese.
Identifiers: Land disposal, Manure, Lagoon water, DTPA, Soil Extracts, Nutrient availability.

The effects of beef-feedlot manure and lagoon water on DTPA-extractable iron, zinc, manganese, and copper of a silty clay loam soil, concentrations of these elements in corn (Zea mays L.) forage and leaf tissue, and their uptake by corn forage were studied in the field. The pH of the soil studied was not appreciably changed by the manure applications during the two years of the study. However, the soil availability (as measured by the DTPA extraction) of Zn, Fe, Mn, and to a lesser extent, Cu was increased. Manure applications enhanced corn-leaf and forage concentrations of Zn, and Mn and corn-forage uptake of Mn. There was a consistently high correlation of the Mn plant data with the cumulative manure applied. Manure applications were shown to increase the availability of Zn and Mn in the soil studied but did not consistently affect corn concentrations of Fe and Cu and uptake of Fe, Zn, and Cu. Increased DTPA-extractable Fe, Zn, and Mn were found in soil cores taken from plots that had received two years of beef-feedlot lagoon water; Cu was unaffected. This study showed that lagoon water effectively increased the availability of Fe and Mn. The study also indicated that feedlot wastes were sources of the trace elements Fe, Zn, and Mn. Annual applications of either manure or lagoon water could correct the soil deficiencies of these micronutrients. (Penrod-East Central)

### 2491-A8, B2, C2, E2

### SOME EFFECTS OF BEEF-FEEDLOT EFFLUENT APPLIED TO FORAGE SORGHUM GROWN ON A COLO SILTY CLAY LOAM SOIL,

Former Research Assistant, Nebraska University, Lincoln
J. E. Sukovaty, L. F. Elliott, and N. P. Swanson
Journal of Environmental Quality, Vol. 3, No. 4, p. 381-388, October-December, 1974. 6 fig, 6 tab, 30 ref.

Descriptors: Feedlots, Effluent, Agricultural runoff, Crop response, Forage sorghum, Nutrients, Cations, Phosphorus.
Identifiers: Application rates, Soil solution, pH.

The effects of beef feedlot effluent and water additions to a forage sorghum were compared during two consecutive growing seasons. Increased forage production in both years of the study resulted from the addition of beef-feedlot effluent. The highest yield for both years was obtained from an application rate of 25 cm-year (2.5 cm-week) and this was significantly higher than yields from other treatments during the second year. The above application rate may be near the optimum for maximum production. Yields were not increased by a higher application rate of 50 cm-year (5 cm-week). However, no major forage yield reductions were observed from the higher application rates. There was a slight additive result noted on the $NO_3$–N content of the plant material as a result of the effluent addition. No appreciable change in soil $NO_3$-N concentrations, as affected by effluent addition, was indicated. The concentrations of Ca, Mg, and Na, and K in the forage sorghum were not affected by the application of beef-feedlot effluent. During the 2-year study, phosphorus increased in the surface 10 cm of the soil as the effluent application was increased. A slight increase of Ca, Na, and K was noted in the soil solution as a result of effluent addition. Few problems in crop production should be offered by feedlot-effluent disposal at the crop nutrient requirements. It was indicated that phosphorus would be the limiting factor in effluent application. (Penrod-East Central)

### 2492-A6,A10,A13,B2,E2,F1

### ANIMAL WASTE MANAGEMENT THROUGH CONTINUOUS SUBSURFACE INJECTION,

Agricultural Engineering Department, Colorado State University, Fort Collins
R. C. Ward, J. L. Smith, and D. B. McWhorter
Presented at the 1975 Annual Meeting, American Society of Agricultural Engineers, University of California, Davis, June 22-25, 1975, 15 p. 3 tab, 8 ref.

Descriptors: Waste disposal, Equipment, Costs, Environmental effects, Odor, Aesthetics, Insects.
Identifiers: Subsurface injection.

This paper describes an animal waste management program for liquid manure systems which overcomes many economic problems and which satisfies environmental constraints. The described program utilizes a conventional liquid manure system from the feedlot to the storage pit, with a continuous subsurface injection system being used for actual disposal. This continuous system overcomes many of the limitations associated with a batch (tank wagon) operation. The main purpose of subsurface injection is to thoroughly mix the manure with the soil, utilize minimum power, and not have the manure exposed directly to the air. Such disposal permits rapid drying and repeated applications at frequent intervals. The manure is covered by the soil at such a depth that aerobic conditions prevail, which greatly reduces the odors and insects normally associated with land disposal of manure. The waste management operations aesthetics are greatly improved for the nearby neighbors and the dairy farmer. An economic comparison of the system with other systems is given and environmental constraints on the system are briefly discussed. It was concluded that the continuous subsurface injection system offers an environmentally sound method of disposing of animal wastes and reduces labor costs. (Penrod-East Central)

2493-D3, E3

### FUEL FOR THOUGHT: IS STOCKPILED ENERGY GOING TO WASTE?,

J. L. Parker
Western Livestock Journal, Vol. 52, No. 26, April 1974, p.66-68, April, 1974. 4 fig.

Descriptors: Methane, Fertilizers, Feedlots.
Identifiers: Bio-gas digester.

This report examines the production of methane and ammonium type fertilizers from controlled natural digesters. The process of gas production is one of anaerobic decay. Utilizing this process for reclaiming concentrations of animal waste is becoming more economically feasible since natural gas shortages are affecting fertilizer production. This form of natural bacterial digestion is a biological process which achieves maximum results when the waste material is maintained at a temperature range of 75 to 90 degrees F. If managed properly, it can be free of air pollution. The use of feedlot manure in this process is logical since in terms of purity, feedlot manure is an unadulterated product of uniform consistency in both gas and fertilizer values. From one pound of dry feedlot manure, approximately one cubic foot of gas averaging 70 per cent methane can be generated. The heat value of the gas produced is about 650-700 B.T.U.s per cubic foot. This compares with 450 B.T.U.s per cubic foot of coal gas generated in English gas plants. The digested sludge contains nitrogen mainly in the form of ammonium. By drying the digested sludge as a filter cake, a concentrated fertilizer is produced. The most successful continuous cycle bio-gas digesters have been in the form of horizontal tanks divided by a half wall down the center. This type seems to yield maximum production of gas while achieving maximum reduction of the wastes and consequent increase in concentrated fertilizer values. (Penrod-East Central)

2494-A2,A8,B2,B3,C2,E2,F1

### TREATMENT AND ULTIMATE DISPOSAL OF CATTLE FEEDLOT WASTES,

Kansas State University, Manhattan
H. L. Manges, R. I. Lipper, L. S. Murphy, W. L. Powers, and L. A. Schmid
Environmental Protection Agency Report No. EPA-660-2-75-013, June, 1975, 136 p. 44 fig, 26 tab, 78 ref.

Descriptors: Feedlots, Waste treatment, Waste disposal, Anaerobic lagoon, Water pollution, Rainfall, Soil chemistry, Soils.
Identifiers: Land disposal, Water pollutants, Great Plains, Environment.

A study was conducted to determine the characteristics of beef feedlot wastes, both runoff and manure, and the optimum application rate of these wastes to land. The project was located at a commercial beef feedlot in southcentral Kansas. Characteristics of beef feedlot wastes varied widely with season. Near maximum corn forage yields, without excessive accumulation of salt in the soil, were obtained from waste application rates necessary to meet nitrogen fertilizer recommendations. At these waste application rates, basic intake rate of water into the soil was increased. Net income from irrigated corn production was sufficient to make application of feedlot manure with disposal as the main objective unprofitable. Land application rates of beef feedlot wastes should be based upon the results of laboratory analyses of wastes from each feedlot. Feedlot wastes should be applied at rates necessary to meet nitrogen fertilizer recommendations. A salt-alkali test should be made annually on the surface soil to monitor changes in soil salinity levels. (Manges-Kansas State University)

2495-A3, A5, A8, B1, E2, F3, F4

### RESEARCH STATUS ON EFFECTS OF LAND APPLICATION OF ANIMAL WASTES,

Kansas State University, Manhattan
W. L. Powers, G. W. Wallingford, and L. S. Murphy
Environmental Protection Agency Report No. EPA-660-2-75-010, June, 1975, 96 p. 5 fig, 13 tab, 233 ref.

Descriptors: Soil disposal fields, Agricultural runoff, Research and development.
Identifiers: Groundwater pollution, Soil contamination, Soil properties, Application rates.

The primary purpose of this report was to review the literature and analyze research needs on the effects of land application of animal waste. An additional purpose was to assemble published information on application guidelines for animal waste. Included in this report are information on the characteristics of waste, effects of waste on soil and water near application sites, application rates, application techniques, and research needs. This report is organized into six main topics: (1) climate, waste, and soil classification; (2), waste composition; (3), effect of waste on the environment; (4), application rates based on waste constituents; (5), application techniques; and (6), research needs. The climate, waste, and soil classification systems were developed to allow comparison of the effects of animal waste applications on land in various parts of the country. The composition of the waste in each climate was tabulated and values compared. Comparisons between climatic regions were not possible because of the large variability within regions. Because of this variability no average composition for a given waste in a given climatic region was possible. The effect of the waste on the environment was measured in terms of the possible final disposition of the waste constituents. These constituents could accumulate in the soil, move to the ground water, run off the soil surface, or be taken up by plants. Attempts were made to assemble application guidelines from the various parts of the country. (Powers-EPA)

2496-A6,A7,A10,B2,D3,E2

### K.S.U. AEROBIC SWINE WASTE HANDLING SYSTEM (6 YEARS OF PROBLEMS AND PROGRESS),

Department of Animal Science and Industry, Kansas State University, Manhattan
B. A. Koch, R. H. Hines, G. L. Allee, and R. I. Lipper
Unpublished Paper No. 20-15, Kansas State University, Manhattan, 15 p. 3 fig, 3 tab.

Descriptors: Kansas, Aerobic conditions, Dusts, Costs, Odor.
Identifiers: Swine, Oxidation waste disposal system, Flies, Foam control.

The purpose of this report was to evaluate the use of an aerobic waste-oxidation system for handling swine wastes. The main operational problem of this unit was a layer of foam that did not circulate and which, therefore, dried into a thick crusty layer on the surface of the liquid in the pits. The majority of the additives used to successfully break up the foam alleviated the immediate problem but none seemed to prevent the formation of more foam. By accident, two effective foam dispensers were found. They were Foremost-Soweena (a milk replacer for baby pigs) and Ferma-Grow (a fermentation feed additive). Poloxalene (active ingredient in Bloat Guard) was also found to be an effective foam-control agent. A noticeable odor problem (probably H2S) was not overcome by the foam dispersers. It was controlled and eliminated by regularly adding small amounts of Puritan Liquid Live Microorganisms to each pit. A dust problem was also solved. Overall, the unit is functioning satisfactorily with minimum maintenance and supervision. There are low labor requirements and no odor problems. The application of waste fluid to fields can be done any time the soil isn't too wet (no complaints from neighbors regardless of wind direction or humidity conditions). Pigs are performing satisfactorily in the unit, flies are easily controlled and suitable sanitation is easily maintained. However, operational costs have been higher than desired. (Penrod-East Central)

2497-A4,B1,C2,C3,E1,F1,F2

### AGRICULTURE AND THE POLLUTION PROBLEM,

J. C. Street
Utah Law Review, p. 395-403, June, 1970. 16 ref.

Descriptors: Agriculture, Water pollution control, Water pollution sources, Organic wastes, Economics, Regulation.
Identifiers: Pollution.

Agricultural practices are contributing significantly to environmental pollution. Animal and domestic wastes have a pronounced pollutive effect, especially when discharged directly into rivers and streams. Such discharges raise the nitrogen and phosphorus levels of the water and may result in increased concentrations of disease organisms and in undesirable eutrophication of ponds and lakes. In addition, there is the problem of domestic wastes from rural homes, most of which are not equipped with advanced septic systems. The discharge of organic waste matter from the industrial processing of agricultural commodities raises the biochemical oxygen demand of the water into which it is discharged. Over-application of fertilizer and consequent excessive nutrient leaching or loss by runoff is another problem. A small increase in the concentration of phosphorus from fertilizers may result in an algae-bloom and eventually a fouled, oxygen-deficient, stagnant system. Regulations have been put forth in attempts to maintain the quality of the country's waters, but the small producer has not yet been compelled to comply because of lack of resources for enforcement and because of the small farmer's inability to absorb the added costs. (Johnson-Florida)

2498-D2,E3,F1,F3

### SYNTHESIS GAS FROM FEEDLOT MANURE: A CONCEPTUAL DESIGN STUDY,

Department of Chemical Engineering, Kansas State University, Manhattan
C. R. Engler, W. P. Walawender, and L. T. Fan
Contribution No. 37, Department of Chemical Engineering, Kansas Agricultural Experiment Station, Manhattan, December 1, 1973, 34 p. 7 fig, 7 tab, 51 ref.

Descriptors: Design, Equipment, Feedlots, Costs, Chemical properties, Moisture content, Transportation.
Identifiers: Pyrolysis.

This study presents the development of a conceptual plant design to process 1000 T-D (tons-day) of raw manure (50 per cent moisture) to yield a synthesis gas composed of CO, $H_2$, and $CH_4$. Estimated capital investment and operating costs for the plant are presented along with the results of sensitivity analysis, i.e. studies of the effects of variations in the size of the plant, raw manure moisture content, manure composition, and transportation costs on the cost of the synthesis gas. The capital investment required for the plant was estimated at $6.07 MM (million), with annual operating costs at $2.54 MM. It was determined that for a 16 per cent return of investment at current gas prices, the 1000 T-D plant would have to receive a credit of approximately $3.65-ton. To make manure pyrolysis economically feasible, improvements in the process or significant changes in the cost for producing synthesis gas by conventional methods would be needed. (Penrod-East Central)

### 2499-D2, D3, E3

## PAUNCH FEEDING NOW PROFITABLE,

Calf News, Vol. 13, No. 8, p. 14-15, 30, August, 1975. 6 fig.

Descriptors: Economics, Cattle.
Identifiers: Refeeding, Paunch manure, Blood, Chemical treatment, Corral industries.

The economic feasibility of paunch feeding is being investigated in Phoenix, Arizona where Corral Industries has developed a new two-phase system for recovering the liquids and solids from paunch and making an acceptable cattle feed. Preliminary trials have indicated acceptance of up to 70 per cent of the total diet. The paunch is collected and extruded. Tramp metals are magnetically removed from the solids and then the material is chemically treated to kill enteric bacteria, to mask odor, to create a residual kill of bacteria, and to add food value. The treatment also degrades the fiber to make the material more available the second time around. Although the initial operation was a mobile unit, a full-scale model is now operating to get some of the bugs out of the designing and handling aspects of the operation. Through the process, blood from the packing house becomes a valuable feed supplement along with the roughage. Basic equipment for recovery is briefly discussed. According to test results, a 1,000 head kill should feed 1,000 head in the feedlot. The pay back period of the operation would be a little over two years. However, if the blood recovery system were added it would take only a year. (Penrod-East Central)

### 2500-B2, D2, D3, E3

## THE BIO-GAS PLANT: GENERATING METHANE FROM ORGANIC WASTES,

R. B. Singh
Compost Science, Vol. 13, No. 1, P. 20-25, 1972. 3 fig.

Descriptors: Recycling, Organic wastes, Methane, Design, Slurries, Fermentation.
Identifiers: Bio-gas plant.

Bio-gas plants can be designed to work efficiently and to meet energy needs effectively in nearly any instance where natural gas can be used. Bio-gas is very similar to natural gas in composition and can be produced from farm wastes. The size of a bio-gas plant depends upon the production requirement and the amount of raw material available. Other considerations are the suitability of the raw material, the temperature of the operating cycle and the length of the operating cycle. Small gas plants can produce up to 500 cu. ft. of gas per day, and large plants can produce up to 9,000 cu. ft. per day. Materials used are usually cow dung and vegetable wastes with a carbon to nitrogen ratio of optimally 25:1. The operating cycle works best when warm and should be insulated if installed in colder climates. Agitation is not always required for small plants but is usually mandatory for large plants. The bio-gas is collected by a metal drum inverted over the fermenting slurry. The pressure keeps the gas from escaping, and the gas collects in the drum for storage. Bio-gas plants can be built above ground or under ground. Above ground design provides for a radiant heat source from the sun, while under ground design assists the gravity feed system for slurry to enter the plant. (Sanders-East Central)

### 2501-D2, E3, E4, F1, F6

## MANURE PROCESSING YIELDS PRODUCT USED IN PLASTICS,

J. D. Kendall, Editor
Feedstuffs, Vol. 47, No. 32, p. 12-13, August 11, 1975.

Descriptors: Recycling, By-products, Feedlots, Texas, Fertilizers, Gases, Plastics, Pipelines, Cattle, Economics.
Identifiers: Ethylene.

In research with the objective of showing that feedlot waste could be converted to synthetic gas for producing fertilizer, Dr. James G. Halligan, Texas Tech chemical engineer, found that cattle manure yields ethylene which is used in plastics manufacturing. R. Douglas Kreis, project officer of the EPA agricultural waste research program at Ada, Oklahoma, stated that, on the basis of the Texas Tech research, ethylene could be recovered at the rate of 180 lbs. per dry ton of beef cattle manure. The process seems to be economically feasible with the use of pipelines to transport the gas, and it appears to be a constructive solution to the disposal of the 2-4 million tons of manure produced annually on the Texas plains. Other experimentation is continuing to determine uses for other products yielded from this process—other gases, tars, wastewater, and an inert residue containing ash. It is felt that the ash might be used for playa lake fills, road fills, or in construction. (Sanders-East Central)

### 2502-A2,A3,A5,B2,B3,C2,C3

## A SURVEY OF EFFECTS OF ANIMAL WASTES ON STREAM POLLUTION FROM SELECTED DAIRY FARMS,,

Department of Dairy Science, Clemson University, Clemson, South Carolina
J. J. Janzen, A. B. Bodine, and L. J. Luszcz
Journal of Dairy Science, Vol. 57, No. 2, p. 260-263, February, 1974. 3 tab, 5 ref.

Descriptors: Water pollution, Dairy industry, Sampling, Coliforms, South Carolina, Biochemical oxygen demand, Chemical oxygen demand, pH, Nutrients.

A study was conducted in South Carolina in which water was sampled from streams adjacent to selected dairy farms. The waste management systems utilized by these farms were lagooning, dry disposal, and liquid manure handling. Stream samplings were taken above, adjacent to, and below the major animal waste drainage areas. It was determined that 42 per cent of the selected farms contributed in varying amounts to a reduction in stream water quality. Twenty-six per cent of these farms contributed to significant increases in fecal coliform concentrations. Studies are underway to determine the effects of depth, site, and frequency of sampling on measures of stream water quality. Water quality data is also being collected for streams draining virgin lands that are free of domesticated animals. (Penrod-East Central)

### 2503-A11, C3, D2, E3, F1

## THE RECYCLING OF ORGANIC WASTE: INTENSIVE CATTLE PRODUCTION,

Asia Research Pte. Ltd.
Asia Research Pte. Ltd., Stamford House, Stamford Road, Singapore 6, 1974, 36 p. 40 fig, 24 tab, 62 ref.

Descriptors: Recycling, Organic wastes, Technology, Fermentation, Cattle, Poultry, Costs, Feedlots.
Identifiers: Refeeding, Microbial contamination.

The recycling system is bound to be widely adopted in order for the cattle industry to meet future pollution control and food shortage problems. Technology for recycling animal wastes for beef cattle consumption has been developed by Dr. Z. Muller of Asia Research (Pte.) Ltd. The technology is based on lactic fermentation which converts organic waste (including animal waste, industrial and agricultural by-products and municipal garbage) into inexpensive but highly efficient animal feed. The fermentation process has eliminated the problem of microbial contamination and thus cancels the need for any costly drying of the organic waste. Dr. Muller emphasizes the intrinsic value of poultry litter as the most valuable source for conversion into cattle feed when compared to poultry manure, cattle litter, and feedlot waste. Advantages of organic waste recycling techniques are: (1) increased production of beef of a higher quality, (2) more economical beef production, (3) beef production, without arable or agricultural land, (4) the release of cereals and vegetable protein for human and monogastric consumption and (5) abatement of a pollution problem. Consultancy is offered by Asia Research (Pte.) Ltd. for those who may be interested in conversion of organic waste for a feedlot operation or those who wish to consider the processing of organic waste as a commercial feed ingredient. (Battles-East Central)

### 2504-A11, B1, B5, E1

## STRIP-MINE FEEDLOTS,

B. McElroy
The Furrow, Vol. 78, p. 15, April, 1973. 1 fig.

Descriptors: Strip mines, Feedlots, Cattle, Performance, Runoff, Ohio.
Identifiers: Waste management.

Ohio State University has found an abandoned strip mine to be a practical feedlot for cattle. An initial cost of $125 was required to build a barbed-wire fence around a couple of acres of abandoned strip pit and to pipe water to the lot from a pond in a field above the pit. Many benefits were found to be gained by this sort of an arrangement. The first group of steers tested in the lot actually gained more efficiently than another group fed in a total-confinement unit. Even though the animals in the strip-mine feedlot didn't have shelter, they were not stressed by bad weather because the vertical high wall left by the mining operation made an excellent weather break. Manure removal was not found to be necessary. The steers trampled their manure down into the stony subsoil. Soil conservation experts say that this action will eventually leach the mine acids out of the soil and permit grass to grow. Evaluation of a bigger strip-mine lot was similar, with average daily gain of the steers being better than two pounds per head. The study concludes that now the scars left by strip-mining can be put to good use and at the same time make the cattle business a little better than the sometimes-marginal business it is. (Penrod-East Central)

### 2505-A11, B3, B5, C2, C3

## THE MICROFLORA OF POULTRY HOUSE LITTER AND DROPPINGS,

Department of Poultry Husbandry, Ohio State University, Columbus
E. R. Halbrook, A. R. Winter, and T. S. Sutton
Poultry Science, Vol. 30, p. 381-388, 1961. 5 fig, 9 ref.

Descriptors: Bacteria, Molds, Yeasts, Litter, Analyses, pH, Lime, Temperature.
Identifiers: Microflora, Vitamin B-12, Corn cobs, Shavings, Bark.

Tests conducted concerning the relationship of litter management to the vitamin $B_{12}$ requirements of growing chicks instigated a study of the microflora of the litter and droppings of these test chicks to determine the possible relationships to vitamin $B_{12}$ content. The litter that was analyzed was used by chicks during the first 8 weeks of brooding. Results are presented for the microflora analyses of 85 litter samples and 60 droppings samples. The litter varied from unused litter to litter which had been used more than a year. Corn cob litter was predominantly studied, but shavings and bark were also analyzed. Bacteria, molds, and yeasts showed definite increase in poultry which had aged up to at least 6 weeks . Built-up litter (over 1 year old) contained fewer yeasts, molds and coliforms than either weekly changed of unchanged litter (1-8 weeks of use) and fewer lactobacilli and enterococci than unchanged litter. Liming built-up litter at a rate of 10-15 lbs. per 100 sq. ft. of floor space as needed for conditioning the litter reduced noticeably all classes of bacteria, yeasts, and molds. Feed and water appeared to be major factors affecting the microflora of the intestinal tract of chickens. The total count for both aerobes and anaerobes plus aerobes was highest at 30 degrees C storage, corresponding to the higher vitamin $B_{12}$ content reported at this temperature. The pH of poultry litter increased from 6.3 for new cob litter to 7.0 for unchanged litter after 1-8 weeks for use, and 8.0 for built-up litter. Limed built-up shavings litter showed a pH of 8.6 as compared to 7.5 for unlimed litter. The change in pH of litter as it ages probably explains the decrease in yeasts and molds present. (Penrod-East Central)

2506-A1, A4, B1

### AGRICULTURE AND NATURE'S NUTRIENT CYCLES,

The Fertilizer Institute, Washington, D. C.
W. H. Garman
In "Relationship of Agriculture to Soil and Water Pollution," Cornell University Conference on Agricultural Waste Management, Rochester, New York, 1970, p. 11-20. 2 tab, 12 ref.

Descriptors: Agriculture, Water pollution, Nitrogen fixation, Photosynthesis, Eutrophication, Ammonia, Feedlots.
Identifiers: Nutrient cycles, Nitrogen oxides.

Photosynthesis and nitrogen fixation are the two most important processes going on today in nature. Animal life would soon disappear without them, even though neither is characteristic of the animal kingdom. The objective of this report is to determine the effect agriculture has on nature's nutrient cycles. One way that agriculture affects the nutrient cycles is its possible contribution to the pollution of streams and rivers. Because of the large number of variables involved and some unknown factors, it is much more difficult to determine the contribution of farms than a city or factory to the pollution load of a stream. There is a considerably larger amount of nitrogen in such forms as nitrogen oxides and ammonia that occur in the rain, near livestock feedlots, cities, and certain types of industrial plants. Nitrogen oxides going into the atmosphere in the USA from automobile exhausts alone, and being returned to land, probably exceed two million tons of nitrogen a year. Too often these natural and artificial atmospheric inputs are almost completely overlooked and may end up being assigned to the agricultural sector. Agriculturalists now realize that to determine agriculture's exact contribution to pollution, sufficient information is lacking. Several years of tedious work in numerous watersheds by skilled individuals is required to obtain this information. Regarding the agricultural sector, agronomists have compared major streams in non-agricultural regions with similar ones in various agricultural regions which they have studied. This comparison will probably show us that agricultural land adds no more nutrients to water than does nature herself. (Penrod-East Central)

2507-A6, A8, B2, B3, B4, C2, D1, D2, D3, E2

### MANAGE MANURE FOR ITS VALUE,

College of Agricultural and Life Sciences, Wisconsin University, Madison
L. M. Walsh, R. F. Hensler and E. E. Schulte
Circular A1672, Wisconsin Agricultural Extension Service, Madison, May, 1975, 6 p. 5 fig, 3 tab.

Descriptors: Solid wastes, Liquid wastes, Crop response, Odor, Lagoons, Agricultural runoff, Leaching.
Identifiers: Nutrient conservation, Land disposal, Volatilization.

Although manure is a valuable by-product of the livestock industry, only a fraction of its potential crop-producing value is realized. Some of the reasons are: poor distribution when applied; runoff losses; leaching; and volatilization. The purpose of this report is to discuss the fertilizing value of manure, the quantity and composition of manure produced by Wisconsin livestock, and the methods of conserving and handling manure. Manure adds nitrogen, phosphorus, organic matter, potassium and other elements such as magnesium, boron, copper, calcium, sulfur, manganese and zinc to the soil. Factors affecting manure composition are the kind and amount of litter, the kind of animal, digestibility of the feed consumed, and handling and storage procedures. The distribution of nutrients in liquid and solid manure is discussed. Of the crops which can utilize nitrogen and other nutrients from the manure, corn responds best. Several methods of conserving nutrients are: (1) reduce liquid losses, (2) consider chemical preservatives, and (3) reduce volatilization losses. Methods for solid manure handling that are discussed are: (1) daily-spread manure, (2) stacked manure, and (3) loose housing manure. Liquid systems of manure handling include: (1) aerobic lagoons, and (2) anaerobic lagoons. Chlorine and hydrated lime are important chemicals in the control of odor. (Penrod-East Central)

2508-A2, A6, B2, B3, B4, E2, E3

### EMERGING ISSUES IN FEEDLOT WASTE MANAGEMENT,

J. M. Sweeten
Feedlot Management, Vol. 17, No. 5, p 16, 18, 23, 26, May, 1975.

Descriptors: Feedlots, Agricultural runoff, Odor, Recycling.
Identifiers: Waste management, Application rates, Refeeding, Sediment management.

This report discusses areas of needed improvement that are emerging in feedlot waste management. Since many feedlots have invested from \$.50 to \$7.00 per head of capacity for runoff control systems, care needs to be taken to protect these investments. One common problem is failure to dewater the retention structures within a prescribed time period following a major storm. Another problem is the proper determination of the right runoff application rates on crop or pasture land. Sediment management in retention ponds must also be dealt with. Possible solutions for these problems are projected. The quality of manure used in crop disposal has recently become a pressing issue. Attempts are being made to improve manure quality through better handling techniques. Animal wastes have been found to have value when recycled as gas or as feeds, but there are still problems to be worked out. Although all of the above are important aspects of feedlot management, the area with the greatest need of research is odor control. Because of the legal aspects of the odor problem, there is a great need for more research on odor measurement, odor control techniques, and prediction of odor transport phenomena. (Penrod-East Central)

2509-A6, A11, E3

### DEHYDRATED POULTRY WASTE IN POULTRY RATIONS,

Department of Poultry Science, The University of British Columbia, Vancouver 8, British Columbia, Canada
J. Biely, R. Soong, L. Seier and W. H. Pope
Poultry Science, Vol. 51, p. 1502-1511, 1972. 15 tab, 10 ref.

Descriptors: Performance, Health, Economics, Odor.
Identifiers: Dehydrated poultry waste, Rations.

Dehydrated poultry waste, with less than ten per cent moisture content, was fed at levels of five to thirty percent to chicks, broiler stock, and laying hens in rations calculated to be approximately isonitrogenous (total N) and isocaloric. When the DPW was included in a well-balanced ration, no detrimental effect was observed on the health of the birds. Growth and feed efficiency decreased when the DPW content was increased beyond ten per cent. The economics of the over-all operation will require much study. "Even if the poultry industry had to subsidize the production of DPW to make it competitive with other ingredients, it would be justified, since it would allow the poultry men to stay in business with fairly odor-free premises and at the same time contribute to the improvement of the 'quality' of the environment." (Whetstone, Parker, and Wells-Texas Tech University)

2510-C2, E3, F1

### SECOND THOUGHTS ABOUT RECYCLING POULTRY WASTES,

Cornell University
M. L. Scott
Egg Industry, Vol. 5, p. 52, 54, May, 1972. 3 tab, 1 ref.

Descriptors: Recycling, Poultry, Phosphorus, Economics.
Identifiers: Refeeding.

Dried poultry waste has a low energy content. When used in a poultry ration its value is primarily for phosphorus. Viewed as a manure disposal method, it may be uneconomical since only a decreasing percentage of the total manure produced can be refed to the same flock. (Whetstone, Parker, and Wells-Texas Tech University)

2511-B1, D2, E2, F1

### SHOULD SUPERPHOSPHATE BE USED ON MANURE?,

Poultry Digest, Vol. 31, p. 42, 1972.

Descriptors: Poultry, Drying, Fertilizers, Economics.
Identifiers: Superphosphate.

Superphosphate has been used on manure accumulations below cages as a water absorbent for some years. After a four- to six-inch layer accumulates, natural drying renders the superphosphate relatively ineffective. Since superphosphate is frequently used as fertilizer, however, it becomes a question of the economics of adding it before or after field spreading. (Whetsone, Parker, and Wells-Texas Tech University)

2512-A11, E3

### INFLUENCE OF FEEDING DEHYDRATED POULTRY WASTE ON BROILER GROWTH, AND MEAT FLAVOR, AND COMPOSITION,

Dairy and Poultry Science Department, Kansas State University, Manhattan
F. E. Cunningham and G. A. Lillich
Poultry Science, Vol. 54, No. 3, p. 860-865, May, 1975. 4 tab, 23 ref.

Descriptors: Performance, Feeds, Taste.
Identifiers: Refeeding, Dried poultry wastes.

Three levels (9.6, 19.1, and 38.2 per cent) of dehydrated poultry waste were fed to broilers to determine: (1) the resulting flavor of the flesh, (2) growth and feed efficiency, and (3) certain parameters of carcass composition and quality. Flavor differences were studied by use of the triangle taste test. Panel members were unable to detect flavor differences between the 0 per cent and the 38.2 per cent DPW treatments. Dark meat was analyzed for protein, ether extract, calcium, phosphorus and TBA value. No significant differences were found between the DPW fed meat and the control meat. Poultry fed 38.2 per cent DPW had the poorest performance, as evidenced by lower average live weight, lower average eviscerated weight, and poorer feed conversion. It was determined that dried poultry waste may be fed to broilers at a level below 20 per cent without serious consequences. (Penrod-East Central)

## 2513-A6, D1, D2

### THAT ODOR!,

A. T. Sobel
Compost Science, Vol. 7, p. 19-21, Spring-Summer, 1966. 3 fig, 9 ref.

Descriptors: Odor, Control, Ventilation, Absorption, Adsorption, Chemical reaction.
Identifiers: Detection, Combustion, Masking, Counteraction.

Odor is defined as a substance that has the property of affecting the sense of smell. Since smell means the perceiving of a substance by the excitation of the olfactory nerves, the author states that odor cannot exist if people are not present to detect it. There are two general categories of odors—source odors and ambient odors. Source odors are defined as odors at the point of origin. Ambient odors are those that are distributed in the atmosphere. Several odor characteristics are important in considering the source, detection, and control of these odors. They are quality, strength, and occurrence. Each of these are defined and the feasibility of using each in odor detection is examined. Odor control is discussed from the viewpoint of eliminating either the source or the odor itself. The methods used to control gaseous odor are ventilation, combustion, absorption, adsorption, masking, counteraction and chemical reaction. Odor control depends on the nature of the odor, good housekeeping, and a working management program. The study concluded that source elimination is a more realistic approach than odor elimination. (Penrod-East Central)

## 2514-A6,B1,B2,B4,E2,F1

### DAIRY WASTE MANAGEMENT SYSTEMS,

Department of Agricultural Engineering, University of Minnesota, St. Paul
D. W. Bates
Journal of Dairy Science, Vol. 56, No. 4, p. 495-499, April, 1973. 6 ref.

Descriptors: Dairy industry, Minnesota, Confinement pens, Waste storage, Waste disposal, Odor, Ventilation.
Identifiers: Housing, Stall barns, Free stall barns, Land disposal.

Waste handling systems may range from a gutter cleaner and daily hauling with a manure spreader to extended storage in concrete tanks whose contents are pumped and spread periodically. Two general classes of dairy housing in Minnesota, conventional stall barn and free-stall barn, are discussed in relation to manure handling. Free-stall barns can be either cold (open, uninsulated buildings where natural air movement provides ventilation and the barn temperature approximates the outside temperature) or warm (completely insulated and mechanically ventilated). The cost variation between the two free-stall systems stems from the manure handling system and the housing structure. Manure storage capacity is usually limited to a few months because of the cost. How the manure is to be disposed of or utilized is essential in deciding on how much storage should be provided. The effects of cold weather, deep snow, soft fields in the spring, and fields planted to crops must be considered. Stall barns with grated gutters or free-stall barns with slatted floors, both with under-the-building manure storage, offer a suitable system with minimum labor. Ventilation systems of high capacity must be provided for all confined units. Waste heat from the dairy barn ventilation system will prevent freezing. (Penrod-East Central)

## 2515-A8, C1, C2, E2

### PHYSICAL AND CHEMICAL PROPERTIES OF SOIL ASSOCIATED WITH HEAVY APPLICATIONS OF MANURE FROM CATTLE FEEDLOTS,

Nebraska Agricultural Experiment Station
A. E. Tiarks, A. P. Mazurak, and L. Chesnin
Soil Science Society of America Proceedings, Vol. 38, p. 826-830, 1974. 5 fig, 3 tab, 18 ref.

Descriptors: Physical properties, Chemical properties, Soils, Feedlots, Cattle, Hydraulic conductivity, Electrical conductance.
Identifiers: Land disposal, Organic carbon, Particle density, Modulus of rupture.

The objectivies of this study were: (1) to determine the effects of heavy manure applications on the physical properties of soil; (2) to determine the amount of manure, if any, that would deteriorate these physical properties; and (3) to determine the effects of the tillage depth in mixing manure into the soil. Cattle feedlot manure was applied to Sharpsburg silty clay loam at 0, 90, 180, and 369 metric tons $ha^{-1}$ $year^{-1}$ at depths of 10, 20, and 30 cm. At 10 cm depths, the heaviest applications increased soil organic carbon 2-5 per cent after 2 years. It was found that organic carbon content increased linearly with increasing amounts of manure. Increasing the tillage depth resulted in smaller increase in the organic carbon content of the soil. Particle density decreased linearly as a result of higher amounts of organic matter in the soil. Increasing application of manure significantly reduced bulk density. Heavy application of manure increased the geometric mean diameter (GMD) of water-stable aggregates in the surface 10 cm. of the soil. Modulus of rupture decreased with increasing amounts of manure because the increase in organic matter allowed less cohesion of soil particles. Hydraulic conductivity of the soils was extremely variable. Hydraulic conductivity of undisturbed soil cores increased five fold. However, manure applications reduced the hydraulic conductivity of disturbed soils sampled in the fall; there was no effect on spring samples. The heaviest application of manure increased the electrical conductivity of the hydraulic conductivity leachates in both the fall samples and the spring samples. Manure application had decreased effects on soil properties with increased depth of tillage. (Penrod-East Central)

## 2516-A2,A3,A6,B2,E2,F1,F2

### IMPACTS OF IMPOSING SELECTED POLLUTION CONTROLS,

Department of Agricultural Economics, Cooperative Extension Service, Michigan State University, East Lansing
D. Good, L. J. Connor, J. B. Johnson, and C. R. Hoglund
Michigan Farm Economics Report No. 360, Cooperative Extension Service, Michigan State University, East Lansing, January, 1973, 4 p. 2 tab.

Descriptors: Michigan, Dairy industry, Legal aspects, Costs, Agricultural runoff, Odor, Waste storage.
Identifiers: Pollution control, Land disposal, Subsurface disposal.

Three selected pollution control measures are analyzed which might conceivably be applied to Michigan dairy farms. The measures are based on recent actions taken by the Michigan Water Resources Commission and Air Pollution Control Division and on statutes relative to dairy waste management that have been enacted or proposed in adjoining states. The first control measure requires control of surface water runoff at the production site. The second measure, designed to control runoff from fields to which wastes are applied, prohibits winter spreading of dairy wastes. The last measure, designed to reduce odors and field runoff associated with land application of dairy wastes, requires immediate plow-down of solid dairy wastes and-or soil injection of liquid dairy wastes. Twelve "representative" farms were chosen for the study. Adjustments necessary to comply with the control measures were identified. These control measures will cause increased cost of operation which will inevitably be passed on to the consumer. Projections of increased costs are given. (Penrod-East Central)

## 2517-A5, B1

### POLLUTED GROUNDWATER: ESTIMATING THE EFFECTS OF MAN'S ACTIVITIES,

General Electric-TEMPO, Center for Advanced Studies, P. O. Drawer QQ, Santa Barbara, California
J. F. Karubian
EPA Report No. 6804-74-002, July, 1974, 90 p. 6 fig, 36 tab, 29 ref.

Descriptors: Feedlots, Industrial wastes, Fertilizers, Methodology.
Identifiers: Groundwater pollution.

This report presents a method for estimating kinds, amounts, and trends of groundwater pollution caused by man's activities. It describes preliminary research for a number of examples: unlined earthen basins and lagoons used by the pulp and paper industry, petroleum refining, and primary metals industries; phosphate mining wastewater ponds; agricultural fertilizer use; and beef cattle feedlots. It was compiled by use of census data, other statistical data, and descriptions of production processes used. Past and projected volumes and areas covered by potential pollutants are estimated so that geohydrological analysis can be used to estimate the infiltration potential of pollutants. Results are not definitive but intend only to illustrate use of the methodology for geographical areas of interest. (W. E. Rogers–TEMPO)

## 2518-B5, C2

### DISTRIBUTION OF THE MAJOR NITROGENOUS COMPOUNDS AND AMINO ACIDS IN CHICKEN URINE,

Departments of Agricultural Chemistry and Poultry Husbandry, Missouri University, Columbia
B. L. O'Dell, W. D. Woods, O. A. Laerdal, A. M. Jeffay, and J. E. Savage
Poultry Science, Vol. 39, p. 426-432, 1960. 1 fig, 3 tab, 17 ref.

Descriptors: Nitrogen compounds, Urine, Poultry, Amino acids, Ammonia.
Identifiers: Creatine, Uric Acid, Arginine.

Urine from male White Leghorn chicks, 5-6 weeks of age, was analyzed for uric acid, ammonia, urea, creatine and creatinine, and amino acids. Diets fed to these chicks were either (1) a corn-soya diet or (2) purified diets containing as the source of protein, casein, casein and gelatin, casein and supplemental arginine, and liver protein. Uric acid constituted about 81 per cent of the total nitrogen and ammonia about 10 per cent. Amino acid nitrogen made up approximately 2 per cent of the total urinary nitrogen. The proportion of urea increased with the addition of free arginine to the diet, but the creatine-creatinine nitrogen and the distribution of amino acids were unaffected by the diet. (Penrod-East Central)

### 2519-A2,A4,E2,B4,E2,F1,F2

### KEEPING THE FEEDER IN BUSINESS,

Soil Conservation Service, Lincoln, Nebraska
L. G. Jackson
Soil Conservation, Vol. 39, No. 2, p. 10-11, September, 1973. 3 fig.

Descriptors: Nebraska, Feedlots, Regulation, Water pollution, Design.
Identifiers: Soil Conservation Service.

The 17,000 feedlots in Nebraska cause a great many waste management problems. The Soil Conservation Service engineered a system to prevent runoff at the request of a 1000-head Adams County feedlot. A bypass system was devised that involved keeping a farm pond from discharging into the feedlot. A debris basin and holding pond were then designed that would control a 10-year, 24 hour storm that could cause runoff from the lot. The lot was sold before the system was implemented, and the new owners doubled the feedlot capacity, making it necessary for a new debris basin to be installed. The farm pond was changed to a tailwater recovery pit to which all liquid waste was carried. A pipeline was installed to carry liquid waste to the high point in the disposal area for distribution to the croplands by irrigation. Costs of the system were $3700. At the time of this publication, about 650 waste control systems had been installed on Nebraska feedlots, and more were in the design stage. All these feedlots are carefully inspected by the Department of Environmental Control in order to assure that owners do not violate water quality standards. (Sanders-East Central)

### 2520-A9, A10, B5

### POLYVINYL CHLORIDE-INSECTICIDE PELLETS FED TO CATTLE TO CONTROL FACE FLY LARVAE IN MANURE,

Entomology Section, Wyoming University, Laramie
J. E. Lloyd, and J. G. Matthysse
Journal of Economic Entomology, Vol. 63, p. 1271-1281, August, 1970. 2 fig, 7 tab, 28 ref.

Descriptors: Insecticides, Cattle, Toxicity.
Identifiers: Fly control, Feed additives, Larval Mortality, Manure.

The objective of this study was to determine the effects of feeding PVC-insecticide pellets to cattle for the control of face fly larvae and pupae. Determinations were made of larval and pupal mortality as a result of insecticide dosage, polymer pellet size and the concentration of insecticide in the polymer. The length of time that toxic manure was passed after feeding was discontinued, was also studied. Of the systems tested, PVC-diazinon and PVC-dichlorvos were the most promising feed additive larvicides. Larval control was unexpectedly poor in most of the manure samples from cows fed Product V-13 at 0.25 mg dichlorvos kg per day. When XP-515 dosage was increased to 0.5 mg kg per day, larval mortality was complete in all except one of the field-collected manure patties. Smaller fly populations in the barn of the insecticide treated herd indicated that the feed additive may have had some effect in reducing the numbers of these flies. Treated cows showed no symptoms of toxicity. No indication of inhibition of cholinesterase activity in whole blood of cattle was noted when they were fed Shell formula XP-515 at 0.25 and 0.5 mg kg per day. There was no detectable dichlorvos residue in the milk of these cows. (Penrod-East Central)

### 2521-A8, C2, E2

### SOME EFFECTS OF FERTILIZERS AND FARMYARD MANURE ON THE ORGANIC PHOSPHORUS IN SOILS,

Rothamsted Experimental Station, Harpenden, Herts
O. G. Oniani, M. Chater, and G. E. G Mattingly
Journal of Soil Science, Vol. 24, No. 1, p. 1-9, 1973. 6 tab, 41 ref.

Descriptors: Soils, Fertilizers, Environmental effects, Carbon, Nitrogen, pH.
Identifiers: Manure, Organic phosphorus.

This report describes the effects of phosphate fertilizers alone, or with farmyard manure, on the total carbon, nitrogen, and organic phosphorus contents of a range of acid and neutral soils of known history. Organic phosphorus estimated by extraction was less than that estimated by ignition except in soils from Ceylon. Differences in the organic phosphorus estimated by the two methods appeared to increase with the per cent of carbon in the soils. Organic phosphorus amounts averaged 129 ugP/g less by ignition than by extraction in the 3 acid soils from Ceylon which contained the most dithionite-soluble iron. The carbon and nitrogen contents of the Barnfield soils was almost trebled by farmyard manure while the carbon-nitrogen ratios only slightly increased. Little organic phosphorus was accumulated in these soils and the carbon-organic phosphorus ratios were about 190 with farmyard manure, 100 with superphosphate, and 72 without phosphate. In Park Grass soils, nitrogen-organic phosphorus and carbon-nitrogen ratios were 9.7 to 15.7 and 11.5 to 13.0, respectively in the surface layer and 8.5 to 15.4 and 10.3 to 11.0 in the sub-surface soil. The carbon content of Barnfield soils (0-23 cm) was approximately trebied when farmyard manure was applied for 100 years; whereas, organic phosphorus increased on average by one-third. The surface soils of Park Grass had about 6 per cent of the phosphorus remaining from superphosphate accumulated as organic phosphorus at pH 4.5 and only 1 per cent at pH 6.2-6.5. The inositol phosphate contents ($iP_5$-$iP_6$) of the Rothamsted soils and Georgia soils ranged from 17 to 45 per cent of the total organic phosphorus by extraction. The proportions of inositol phosphates in these soils which were least (17 to 22 per cent) in the surface soils from Park Grass were not significantly changed by either farmyard manure or superphosphate. (Penrod-East Central)

### 2522-A8, C2, E2

### THE USE AND VALUE OF ANIMAL WASTE AS FERTILIZER FOR CROP PRODUCTION,

Extension Agronomist, Oklahoma State University, Stillwater
B. B. Tucker, C. H. Burton, and J. M. Baker
Circular E-815, Oklahoma State University Extension, Stillwater, March, 1972, 6 p. 6 tab.

Descriptors: Animal wastes, Fertilizers, Crop response, Nutrients, Cattle, Poultry, Feedlots.
Identifiers: Swine.

Because animal wastes contain certain elements needed for high levels of crop production, the most feasible procedure for disposing of them is by spreading on crop land. There are certain problems, however, associated with this disposal method. The most obvious problems are: (1) the wastes are low analyses, (2) all the nutrients in manure are not always needed for crop production, (3) the application of manure rarely eliminates the need for supplemental fertilizer use, and (4) too much manure can cause burning. Frequent soil tests to monitor the soil chemical constituents are especially desirable whenever manure is being applied to land. Also, soil tests prior to application can serve as a useful guide in ascertaining amounts of fertilizer needed to supplement the manure. This study was undertaken to give a clearer understanding of animal manure value. (Cameron-East Central)

### 2523-A4,B2,B4,C2,D1,D3,E2

### FEEDLOT WASTE DISPOSAL AND WATER POLLUTION.

Extension Agricultural Engineer, Colorado State University, Fort Collins
R. Hansen
Publication AE70-71RWH1, Colorado State University Livestock Days, January, 1971, 5 p. 1 tab.

Descriptors: Feedlots, Agricultural runoff, Water pollution, Lagoons, Settling basins.
Identifiers: Land disposal, Detention ponds, Settling channels.

The principle sources of pollution from feedlot wastes are organic substances, volatile substances, inorganic substances, pathogens, and insects harbored by the waste material. While the constituents of manure are especially a problem if allowed to reach bodies of water, the nutrient content of manure makes it a valuable fertilizer material. One of the major pollution problems of feedlot wastes is agricultural runoff. Studies have indicated that the runoff water can be collected and disposed of by several methods. Options include retention ponds, lagoons, settling basins, settling channels, and land disposal. Biological treatment systems can be used, but it is difficult to operate them satisfactorily with the intermittent flows usually encountered in runoff collection systems. Although the likelihood of groundwater pollution from feedlots seems small, there really is very little information available on this subject. (Penrod-East Central)

### 2524-A2,A6,B1,B2,B3,D3,E2,F2,F4

### POLLUTION—CONTROL TECHNIQUES AND REQUIREMENTS,

A. J. Muehling and D. L. Day
Vertical Coordination in the Pork Industry: Proceedings, AVI Publishing Company, Inc., Westport, Connecticut, 1971, p. 127-138. 4 fig, 7 ref.

Descriptors: Regulation, Illinois, Agricultural runoff, Odor, Permits.
Identifiers: Pollution control, Swine, Waste handling, Guidelines.

The main objectives of this report are: (1) examine the regulations governing pork producers in Illinois; (2) provide guidelines for producers to use in planning swine installations; and (3) discuss systems for handling swine manure. In order to carry out the objectives of the 1970 Illinois Environmental Protection Act, three agencies were created: the Pollution Control board, the Environmental Protection Agency, and the Institute for Environmental Quality. These agencies and their functions are briefly discussed. Possible regulations governing registration, runoff, odor, handling and disposal of swine wastes are examined. Suggestions for pork producer guidelines are: (1) plan an approved method of swine waste handling; (2) consider odor nuisances in locating the facility; (3) control runoff and manure overflow; (4) be considerate of neighbors; and (5) practice good housekeeping. Systems for handling swine manure including simple, complex and combined systems are examined. They include: (1) solid floors—scrape floors and haul; (2) slotted floors—store and haul; (3) slotted floors—lagooning and hauling; (4) slotted floor—oxidation ditch with lagoon; and (5) flushing gutter—lagoon and irrigation. Future waste management possibilities are given which have the common objective of utilizing wastes, instead of creating a disposal problem. Pollution control regulations should result in a concern for uniformity in the regulations, stronger pork producers' organizations, and cooperation with agencies on regulations governing pork installations. (Penrod-East Central)

### 2525-B2, C2, D2, E1, F1

### PHOSPHATE REMOVAL FROM DUCK FARM WASTES,

Cornell University, Ithaca, New York
R. C. Loehr and K. J. Johanson
Journal Water Pollution Control Federation, Vol. 46, No. 7, p. 1692-1714, July, 1974. 10 fig, 7 tab, 6 ref.

Descriptors: Waste water (pollution), Waste water treatment, Ducks (domestic), Lagoons, Lime, Costs.
Identifiers: Phosphate removal, Alum, Ferric chloride, Orthophosphate.

The importance of phosphorus in eutrophication is widely recognized, and high phosphate removals are being required before wastewaters are discharged to surface waters. This report examines the results of detailed studies of phosphate removal from wastewaters from the production of ducks for slaughter. These tests were conducted over a two-year period. In the 1970 study, alum, lime, and ferric chloride were evaluated as capable of achieving high orthophosphate removals and low residual orthophosphate concentrations. Higher chemical quantities were required for the processing wastewaters to accomplish a specific removal than did the duck farm wastewaters. Lime, followed by alum and ferric chloride, was found to be the least-cost chemical involved in phosphate removal. The study showed the economic advantage of matching chemical dosage to wastewater characteristics to obtain a specific orthophosphate removal. The 1971 study showed the orthophosphate concentration in both untreated duck wastewater and aerated lagoon effluent varied considerably throughout the production season. The highest concentrations were in the summer and early fall. The experiment showed that phosphate control equipment should be added between the aerated lagoon and the settling lagoons whenever it is used. Based on Tuttle farm results, phosphate removal increased the operating cost of the existing waste treatment facilities from $0.022 to $0.032-season-bird marketed over a phosphate removal range of 50 to 90 per cent. It was also found that the addition of chemicals increased the amount of sludge to be disposed of, probably doubling the sludge disposal problem. (Penrod-East Central)

### 2526-C2, E3

## COMPOSITION AND DIGESTIBILITY OF CATTLE FECAL WASTE,

D. M. Lucas, J. P. Fontenot and K. E. Webb, Jr.
1973-74 Livestock Research Report, Research Division Report 158, Virginia Polytechnic Institute and State University, Blackburg, July, 1974, p. 110-118.6 tab.

Descriptors: Cattle, Chemical properties, Physical properties.
Identifiers: Refeeding, Digestibility, Dried steer feces.

An experiment was conducted to evaluate the composition and digestibility of cattle manure produced by steers fed a ration containing approximately 50 per cent roughage. Three metabolism trials were conducted using six yearly steers. The composition of the dried steer feces fed was approximately 38.8 per cent NFE, 13.2 per cent crude protein and 71 per cent cell walls, dry basis. Low digestibilities were noted for components of dried steer feces—16.6 per cent for dry matter, 26 per cent for crude protein and 16 per cent for energy. The study showed that dried feces from steers fed a 50 per cent roughage ration has little value for refeeding to steers. Tables are provided showing the composition of the rations for each trial, the chemical composition of dried steer feces, the apparent digestibility and TDN and Metabolizable energy content of basal and feces containing rations, the apparent digestibility and TDN and metabolizable energy content of dried steer feces, and the utilization of nitrogen in basal and dried steer feces containing rations. (Penrod-East Central)

### 2527-A11, C2, C3, D2, D3, E3

## FERMENTATION OF ENSILED BROILER LITTER,

L. F. Caswell, J. P. Fontenot and K. E. Webb, Jr.
1973-74 Livestock Research Report, Research Division Report 158, Virginia Polytechnic Institute and State University, Blacksburg, July, 1974, p. 100-109.

Descriptors: Fermentation, Litter, Pathogens, Drying, Nutrients.
Identifiers: Ensiling, Broilers, Drugs, Refeeding.

The possible presence of medicinal drugs and pathogenic organisms is the main problem confronting the approval of broiler litter for use as a livestock feed. Ensiling litter as it comes from the broiler house or following water addition may make it a more desirable product for several reasons; among them reduction of drugs and pathogens. The purpose of this study was to determine the level of moisture necessary for optimum fermentation of ensiled broiler litter and to evaluate the effect of ensiling on bacterial content. The general purpose of the study was to determine the feasibility of ensiling broiler litter alone in an attempt to obtain guidelines for similar ensiling studies on a larger scale. Study results indicated that broiler litter will sustain fermentation when ensiled if water is added. The moisture level of litter must be increased to at least 30 per cent to initiate active fermentation. The nutrient content of the litter was not harmed by ensiling. Enteric bacteria were destroyed through ensiling, thus rendering the material free of pathogens capable of inducing intestinal or urogenital tract disorders. However, the total bacteria counts of fermented litter may not be as low as desired. (Penrod-East Central)

### 2528-A5, B2, C2, C3, D3

## POLLUTANT MOVEMENT TO GROUND WATER FROM SWINE WASTE LAGOONS,

Department of Agronomy, Virginia Polytechnic Institute and State University, Blacksburg
T. G. Ciravolo, K. L. Hallock, H. R. Thomas, E. R. Collins, Jr., D. C. Martens and E. T. Kornegay
1973-74 Livestock Research Report, Research Division Report 158, Virginia Polytechnic Institute and State University, Blacksburg, July, 1974, p. 5-10. 4 tab.

Descriptors: Groundwater pollution, Lagoons, Anaerobic conditions, Coliforms, Nutrients.
Identifiers: Swine.

Flushing swine wastes into an anaerobic lagoon is a relatively inexpensive waste disposal method. Information from a literature search indicates that there may be seepage from such a lagoon. The purpose of this study is to monitor the effect of seepage from anaerobic swine lagoons on ground water quality. The two lagoons studied are located in high water table soils in the Coastal Plain Region of Virginia at the Tidewater Research and Continuing Education Center and at the Virginia Swine Evaluation Station. The wells, consisting of 2 inch PVC pipe, were water jetted at distances of 10, 50 and 100 ft. from the two anaerobic swine lagoons to depths of 10, 15, and 20 ft. At the 20 ft. depth that was 50 ft. from the lagoon at the Swine Evaluation Station in August and at the 10 ft. depth located 50 ft. from the lagoon in November, the 0.1 ppm Cu recommended limit was exceeded. Chemical-oxygen-demand, coliform bacteria, and concentration of $Cl^-$, $NO_3^-$, $NH_4^+$, soluble phosphate, Mg , K , Na , Cu , Zn , and Mn were the constituents being determined in ground water samples. Preliminary analyses summary shows that U. S. Public Health Department drinking water standards were not exceeded for $Cl^-$, $Cu^{++}$ $NO_3^-$ and $Zn^{++}$ Fluctuations in the chemical constituents concentrations indicated that ground water contamination occurred only at 10 ft. distances. A study is continuing with chemical oxygen demand and fecal coliform bacteria being determined. (Penrod-East Central)

### 2529-A11,B2,B3,C2,C3,D1, D2,D3,E3

## POTENTIAL OF RECYCLING SWINE WASTE,

Illinois University
B. G. Harmon
Presented at Symposium on Utilization of Plant and Animal By-Products, University of Georgia, Athens, December 18, 1973, 10 p.2 fig, 11 tab, 17 ref.

Descriptors: Recycling, Performance, Illinois, Nitrates, Animal parasites.
Identifiers: Refeeding, Oxidation ditch, Swine.

The purpose of this report is to discuss experiments of the author and other researchers in the potential for recycling swine waste. In initial studies animal waste was simply collected, dried and mixed in the diet (Diggs et al., 1965). At Illinois, the recycling research has all been conducted with products of the oxidation ditch (Day et al., 1969). The initial studies are discussed by the author. In following studies, no attempt was made to isolate solids from the liquid of oxidation ditch mixed liquor (ODML), as it was considered as a source of water. In five replications a total of 76 finishing swine were fed twice each day in open troughs (Harmon et al., 1973a). Both gain and efficiency values were significantly greater for pigs receiving ODML even though the differences between treatments were small. The author advises that precautions are essential in the successful use of ODML since under certain conditions, nitrate increases to very high levels. The author also states that parasites must be rigidly controlled in the feeding program. In conclusion, Mr. Harmon says that recycled swine waste provides an available source of nutrients for swine. An oxidation ditch is a system which provides a source of nutrients while minimizing any potential for pollution. (Penrod-East Central)

### 2530-A1,A2,B2,B3,D1,D3,E1, E2,F2,F3,F4

## REVIEW OF RESEARCH AND RECOMMENDATIONS ON ANIMAL WASTE MANAGEMENT CONTROL MEASURES FOR MONTANA WITH SPECIAL REFERENCE TO BEEF CATTLE FEEDLOTS,

Department of Agricultural Engineering, Montana State University, Bozeman
C. M. Milne
Special Report AE-101, Department of Agricultural Engineering, Montana State University, November 10, 1970, 36 p. 3 tab, 29 ref.

Descriptors: Montana, Feedlots, Cattle, Regulation.
Identifiers: Waste management, Pollution control, Guidelines

Definite steps are underway in Montana toward developing a State animal waste control policy. The purpose of this report is to provide guidance for the development of a suitable State policy and administrative mechanism for preventing pollution from livestock operations in Montana. In doing this, the author lists and describes four categories of potential pollution. They are: organic pollution, inorganic pollution, bacteriological pollution and esthetic pollution (nuisance). The major factors contributing to feedlot pollution potential are location, hydrology, feedlot concentration and feed supply. Waste management alternatives for both solid and liquid wastes are discussed. They include: biological stabilization, land disposal for crop growth, high rate land disposal, composting, vacuum filtration, trickling filters, etc. Five procedures are discussed on how to deal with feedlot runoff—(1) Uncontrolled release to a stream, (2) controlled release to a stream, (3) evaporation, (4) controlled release to land, and (5) biological treatment. The author believes, however, that returning the waste to the land for crop production is the most economically feasible system for Montana. A list of recommendations for regulations governing feedlots and a possible outline of feedlot design criteria are given. (Penrod-East Central)

### 2531-A1, A2, A11, B1

## GUIDELINES FOR CATTLE FEEDLOT DESIGN,

Department of Agricultural Engineering, Montana State University, Bozeman
C. M. Milne
Special Report AE-102, Presented at 1971 Montana Nutrition Conference, February 8-9, 1971, 18 p. 5 tab.

Descriptors: Feedlots, Design criteria, Montana, Engineering, Locating, Confinement pens.
Identifiers: Animal health, Unpaved lots, Paved lots, Runoff control, Waste management.

Montana already has the feed and cattle resources on which a feedlot industry can be based. The main objective of this study is to set engineering guidelines for establishment of feedlots. The general functional requirement for a feedlot is to produce a pound of beef at the lowest possible cost, subject to a possible quality constraint. The main materials handled in a feedlot are water, animal wastes, feed, and cattle. Feedlot functional requirements and criteria are related to the following factors: (1) Materials handling, (2) Utilization of equipment and labor, (3) Production and efficiency, (4) Animal health, and (5) Water and air pollution control. Design criteria are grouped into two categories: (1) Location and site requirements, and (2) Facilities design. Each category is individually discussed. The physical requirements of feedlot alternatives are given. Waste management alternatives for various production methods are discussed and a simplified table is also supplied. Housed feedlots have, in general, eliminated the "runoff" problem from the feedlot itself. A general procedure is outlined for the development of a major feedlot installation. (Penrod-East Central)

## 2532-B2, D3, E3, F5

## ALGAL GROWTH POTENTIAL OF SWINE WASTE,

Fulhage, C. D.
Unpublished Ph.D. Dissertation, University of Missouri, Columbia, May, 1973, 96 p. 24 fig, 2 tab, 37 ref.

Descriptors: Algae, Growth rates, Nutrients, Chemical analysis, Carbon, Nitrogen, Phosphorus, Chemical oxygen demand, Ammonia.
Identifiers: Swine, Oxidation ditch.

Research was undertaken to determine the amount of algae which can be grown from the nutrients contained in swine waste after it has undergone aerobic treatment such as that accomplished by an oxidation ditch. Under laboratory conditions, the primary algal nutrients carbon, nitrogen, and phosphorus were monitored along with pH, alkalinity, and chemical oxygen demand. It was concluded that aerobic oxidation is effective in converting organic carbon and nitrogen into inorganic forms available to algae. The loss of nitrogen as ammonia and carbon as carbon dioxide was evident during aeration. Because of this loss, these nutrients became unavailable to algae. In relation to algal growth requirements, phosphorus is by far the nutrient in excess in swine waste. This indicates that carbon and nitrogen must be supplemented to achieve phosphorus fixation. Swine waste offers an algal growth potential of about .2 grams of algae per gram of raw waste. (Cartmell-East Central)

## 2533-A2, A6, B2, B4, E2

## DAIRY WASTE STORAGE PONDS FOR SOIL-PLANT RECYCLING,

Agricultural Extension, California University, Riverside
W. C. Fairbank, E. H. Olson, and G. A. Hutton, Jr.
University of California Agricultural Extension Publication No. AXT-n88, November, 1972, 6 p. 3 fig.

Descriptors: Dairy industry, Waste storage, Irrigation, Design, Liquid wastes, Storm runoff, Odor, Cleaning.
Identifiers: Land disposal, Pond management.

Along with the ultimate beneficial return to the land, waste storage ponds provide a system for collecting, settling, and storing liquified dairy manure and washwater for re-use in barn cleaning and manure transport. The things to consider when ascertaining the desirability of the liquid-waste ponding system are: how it relates to the cow confinement system, manure transport, work simplification, waste management, neighborhood acceptance and expected performance in all weather conditions. The ways in which the dairy waste storage ponds may meet the requirements for storm runoff control are outlined. Design of a waste management facility should be based on cost, safety and performance. The aspects of the liquid-waste ponding system that are examined are: (1) pond layout, (2) pond volume calculation, (3) pond depth, (4) levees and slopes, (5) pond sealing, (6) pipes, (7) pumps, and (8) fencing. Pond management includes the practice of emptying and flushing the ponds at each irrigation. Manure waste water should not exceed 30 per cent of the irrigation volume. The necessary equipment for such management is listed. Odor control and cleaning of the pond are also discussed. (Penrod-East Central)

## 2534-A6,B3,C2,D1,D2,E2,E3

## WHAT IS POULTRY MANURE WORTH?,

Associate Specialist in Poultry Husbandry, Hawaii University, Honolulu
S. McHenry
Compost Science, Vol. 2, No. 3, p. 13-15, Autumn, 1961.

Descriptors: Poultry, Fertilizers, Waste treatment, Recycling, Litters, Phosphate, Nitrogen, Lime, Odor, Nutrients.
Identifiers: Land disposal.

Besides being a good plant food, the organic matter in poultry manure has other important advantages. These include soil-conditioning effect, moisture-holding capacity, and resistance to leaching, which permits a gradual release of plant nutrients. Poultry manure must be treated and stored in order to preserve its nitrogen value. Phosphate is the most effective agent for achieving this. The rate of application should be at least 100 pounds of phosphate for each ton of fresh manure, or 5 per cent of the weight of fresh droppings (20 per cent of the dry weight of manure). Hydrated lime is the most effective deodorizer of poultry manure. Poultry manure removal methods are determined by size of operation, type of housing, and availability of labor. Manure removal methods range from a wheelbarrow and shovel to use of various mechanical cleaners that have been devised. Methods of disposing of poultry manure vary. The manure can be broadcast on the ground and plowed under before planting crops; it may be used in the potting mixture of many potted plants; it may be used on lawns or in flower beds; it may be dried, ground and packaged for farmers and home gardeners; or it may be processed for floor litter. (Penrod-East Central)

## 2535-A11, E3

## FEEDING POTENTIAL OF RECLAIMED FECAL RESIDUE,

Animal Science Department, Auburn University, Auburn, Alabama
W. B. Anthony and R. Nix
Journal of Dairy Science, Vol. 45, p. 1538-1539, 1962. 2 tab, 1 ref.

Descriptors: Feeds, Cattle, Performance.
Identifiers: Refeeding.

Feces from full-fed cattle contain appreciable amounts of undigested feed residue. Not only does fecal grain represent an appreciable loss of feeding value but fecal matter creates a serious disposal problem. Research was done to (1) recover some of the fecal feed, and (2) develop an effective means of disposing of organic residues voided by confined cattle. Cattle consumed a feed mixture containing washed wet fecal residue in amount equal to approximately 40 per cent by weight of the mixture. Cattle fed the fecal residue mixture gained over 3 lb daily and required less than 700 lb of dry matter per 100 lb of gain. For both dairy and beef herds, the relevance of this study is in the potential to derive more than manure value for undigested feed and microbial residues. (Cameron-East Central)

## 2536-A11, C2, E3

## EFFECTS OF RECYCLING DRIED POULTRY WASTE ON YOUNG CHICKS,

Department of Animal Science, Iowa State University, Ames
N. Trakulchang and S. L. Balloun
Poultry Science, Vol. 54, No. 2, p. 615-618, March, 1975. 5 tab, 4 ref.

Descriptors: Diets, Poultry, Performance, Proteins.
Identifiers: Dried poultry wastes, Refeeding, Minerals.

An experiment was conducted to investigate the effects of refeeding dried poultry waste (DPW) in the diets of young chicks. Three experimental diets containing 0, 10, and 20 per cent recycled DPW were formulated isocaloric (2950 Kcal-kg) and equivalent in percentage of true protein (16 per cent), calcium, and phosphorus. The experiment was a randomized complete-block arrangement of treatments in a split-plot design, with numbers of recyclings as subplots. Feed and water were available to the chicks ad libitum throughout the 4-week test period. Weight gain of 4-8 week old birds was significantly depressed by diets containing 10 and 20 per cent DPW; however, feed efficiency was depressed by 20 per cent dietary DPW only. Calcium and magnesium contents of excreta decreased linearly as the number of recyclings increased, while potassium and zinc tended to increase and other minerals remained constant. Increasing DPW in the diet significantly decreased calcium, phosphorus, and iron in excreta and significantly increased sodium, potassium, copper, magnesium, manganese, and zinc. The results indicated that recycled DPW cannot be used successfully unless the calcium to phosphorus ratio (and content) of the diet is adjusted for each recycling. (Cameron-East Central)

## 2537-A2, B2, B4, F1, F6

## MODEL TO PREDICT THE PERFORMANCE OF FEEDLOT CONTROL FACILITIES AT SPECIFIC OREGON LOCATIONS,

Department of Agricultural Engineering, Oregon State University, Corvallis
R. B. Wensink and J. R. Miner
Presented at the 1975 Annual Meeting, American Society of Agricultural Engineers, University of California, Davis, June 22-25, 1975, 23 p. 1 fig, 10 tab, 7 ref.

Descriptors: Performance, Feedlots, Oregon, Waste storage, Design.
Identifiers: Model, Retention basins.

The objectives of this study were to develop a cattle feedlot runoff control model, and to utilize the simulation model to determine relationships between historical climatological data and performance of various runoff retention system designs. The sufficient design method was used to determine the minimum storage volume required to prevent illegal discharges as defined by the DPW Effluent Guidelines. In some locations the use of high capacity irrigation equipment allowed reduction of the storage capacity by over 45 per cent when a larger pumping system was specified. In other locations, due to the precipitation pattern, no benefit was obtained by the use of pumping equipment with capacity in excess of 0.10 (10 year-24 house storms). Utilization of the sufficient design technique requires the compilation of weather data for a unique climatological region under consideration. The model is relatively inexpensive to operate and a complete climatological region can be analyzed for less than $20, once the regions climatic data are computerized. (Cameron-East Central)

### 2538-B4, B5, C2, E3

## FRESH WASTES HAVE MORE NUTRIENTS,

Egg Industry, Vol. 5, May, 1972, p. 54-55

Descriptors: Poultry, Performance, Diets, Proteins, Nutrients.
Identifiers: Refeeding, Dried poultry wastes, Storage time, Production.

The longer poultry manure is stored before dehydration, the less the nutrient value of the dried poultry waste (DPW) will be. A study revealed that protein in DPW produced from manure stored four weeks or less was 30.2 per cent or higher, while DPW produced from the manure stored five weeks or longer ranged from 18.3 to 27.4 per cent. In a second trial, a slight increase in phosphorus was noted (from 2.4 to 2.8 per cent for birds on 12.5 per cent DPW diet, from 2.6 to 3.2 per cent for birds fed 25 per cent DPW diet). Calcium went from 10 per cent in the first week to 7 per cent after the 31st cycle for birds fed 12.5 per cent DPW. Hen-housed production on the 12.5 per cent diet was 62.4 per cent, compared to 59.2 per cent for the 25 per cent diet and 59.6 per cent for the controls. (Cameron-East Central)

### 2539-D1, D2, D3, E3, F1

## MANURE DISPOSAL POSES PROBLEM,

Feedstuffs, October 8, 1960, p. 24

Descriptors: Poultry, Waste disposal, Fertilizers, Costs, Economics, Dehydration.
Identifiers: Processing, Composting, Pelleting.

Disposal of manure seems to be increasing despite its value. Satisfactory disposal is important to many poultrymen who do not grow crops because of the relation of the manure to general sanitation and control of disease and parasites on the farm. An apparent answer is the development of practical and economical machinery which will handle and transport the bulk at costs which will allow a profit. Increased use of poultry manure can be secured only through successfully meeting the competition of manufactured fertilizers. This requires a processing operation with the following phases: (1) dehydration of the manure, (2) composting, and (3) pelleting or crumbling. Pelleting and crumbling increase the cost of the final product. Only where special efforts have been made to promote the sale of the product can anyone hope to cover these processing costs and secure a profit. (Cameron-East Central)

### 2540-A3, A8, E2

## APPLY MORE, NOT LESS, POULTRY LITTER TO REDUCE POLLUTION,

USDA and University of Georgia
A. P. Barnett, W. A. Jackson, and W. E. Adams
Crops and Soils reprint, 1969, 1 p. 1 tab.

Descriptors: Agricultural runoff, Ammonia, Water pollution, Poultry, Litters, Georgia.
Identifiers: Land disposal, Application rates.

Spreading poultry litter on cropland can cause pollution if large amounts of ammonia nitrogen enter surface water runoff. Results from tests utilizing a rainfall simulator have revealed that ammonia runoff may be reduced by applying heavy rates of litter. With heavy rates of litter the combination of initial infiltration of rainfall into the soil, and water held on the surface and in the litter itself is greater than with lower rates, thus less water runs off. It was found that the most practical application rate is 10 tons an acre because with less than 2 inches of rainfall, runoff is very low and because rainfall of more than two inches is rare. (Merryman-East Central)

### 2541-B1,B2,C1,D1,E3,F1,F5

## RECOVERING PROTEIN FROM DAIRY CATTLE WASTES,

Agricultural Engineering Department, Purdue University, West Lafayette, Indiana
J. C. Nye, A. C. Dale, T. W. Perry, R. B. Harrington, and E. J. Kirsch
Transactions of the ASAE, Vol. 17, No. 6, p. 1155-1160, November-December, 1974. 1 fig, 6 tab, 20 ref.

Descriptors: Proteins, Dairy industry, Separation techniques, Microorganisms, Substrate, Feeds.

If the growing World's population is to be fed, a technique for hastening the passage of nutrients through the food cycle is needed. The objectives of this study were: (1) determine the optimum particle size limit and dilution level for separation of usable feed and feed residue from dairy cattle manure; and (2) evaluate the feasibility of growing microorganisms on manure and then harvesting them as a source of protein for animal feed. The significance and limitations of the study were briefly examined. The researchers harvested a protein product which appeared to be chemically sound as demonstrated by the amino acid analysis. The microbial product was an adequate feed supplement as 20 per cent of the ration. However, the inability of rats to use this product as their only protein source indicated that more work is needed for process refinement. This study did not determine the ability of animals other than rats to utilize the microbial protein. The study showed that separation of dairy cattle feces through a 595 micron opening removes a low quality roughage material from the remaining liquid waste. The liquid waste that was removed provided a suitable substrate for bacterial growth. The bacteria grown were a satisfactory protein supplement when containing 30 per cent crude bacteria. Such a system was found to be economically feasible for livestock operations. (Penrod-East Central)

### 2542-A5,A6,B1,B2,D3,E1, E2,E3

## DEVELOPMENTS IN HOG MANURE DISPOSAL,

Editor, Hog Extra Edition, Farm Journal, Ames, Iowa
D. C. Wolf
Transactions of the ASAE, Vol. 8, No. 1, p. 107-109, 1965.

Descriptors: Waste disposal, Lagoons, Cleaning, Design, Sprinkler irrigation, Energy.
Identifiers: Swine, Land disposal, Settling tank.

The ideas for manure disposal are appearing in two phases: (1) cleaning pens, and (b) disposing of the manure on fields. The problem of cleaning has fairly well been solved with three types of self-cleaning pens. They are: (1) solid floor with a deep, narrow gutter at one end of the pen, (2) partially slotted floor, usually with a four-foot section of the pen floor slotted, and (3) completely slotted floors with a liquid-manure storage pit underneath that is the same size as the building. Factors which determine how clean pigs keep their pens are: (1) size and shape of pen, (2) number of pigs per pen, (3) arrangement of pen, (4) method of feeding, and (5) temperature control. Optimal conditions are described. The first decision a farmer has to make when considering a liquid manure system is whether or not he wants to spread it on his fields to utilize its fertilizer value in crop production. He must weigh the factors of costs, time, labor and nuisance in making this decision. An option to manure spreading is lagooning, but this disposal method has drawbacks too. Groundwater pollution and odor may become problems. Faced with this situation some hog producers are trying a four stage system in which manure from a settling tank is disposed of on the land, but the liquid is disposed of in a lagoon. Other methods being tried are sprinkler irrigation and gas recovery for the purpose of generating electricity. (Penrod-East Central)

### 2543-A6, C2

## METHODS FOR MEASURING SHORT-CHAIN FATTY ACIDS AND AMMONIA FROM ANIMAL WASTES,

Microbiologist and Biological Sciences Technician, respectively, U. S. Department of Agriculture, Lincoln, Nebraska
L. F. Elliott and T. A. Travis
Soil Science Society of America Proceedings, Vol. 39, No. 3, p. 480-482, May-June, 1975. 1 fig, 2 tab, 14 ref.

Descriptors: Odor, Gas chromatography, Nitrogen compounds.
Identifiers: Fatty acids, Flame-ionization detector, Amines.

Since it is extremely difficult to identify all odorous compounds that evolve from confined animal areas, a possible alternative would be to identify some specific compounds and/or groups of compounds that may be key contributors to odors. The objective of this report is to describe methods suitable for concentrating and measuring short-chain fatty acids and for separating $NH_3$ from the other volatile N compounds that may be trapped from air. The limit for the flame-ionization detector used in the study was determined to be 10 g/ml with a 1-uliter injection. The per cent recovery generally increased as the fatty acid level increased. Acetic acid was an exception. Study data indicated that short-chain fatty acids can be partially purified and recovered with reasonable accuracy from an NaOH trapping solution. Steam distillation recovery ranged from 61 to 95 per cent. Although light-chain amines interfered slightly with the Nessler's method of $NH_4$-N measurement, the interference was much less than with the other methods tested. Methylamine and ethylamine N interference was much less than with the other methods tested. Methylamine and ethylamine N interference was only about 6 per cent of the equivalent $NH_4$-N. (Penrod-East Central)

### 2544-A8, A11, B3, E2, E2

## LAND DISPOSAL OF BROILER LITTER— CHANGES IN SOIL POTASSIUM, CALCIUM, AND MAGNESIUM,

Soil Scientists, U. S. Department of Agriculture, Watkinsville, Georgia
W. A. Jackson, R. A. Leonard, and S. R. Wilkinson
Journal of Environmental Quality, Vol. 4, No. 2, p. 202-206, March-April, 1975. 5 fig, 3 tab, 20 ref.

Descriptors: Potassium, Calcium, Magnesium, Soil profile, Cattle.
Identifiers: Land disposal, Broiler litter, Grass tetany.

The objective of this study was to provide a description of the effects of heavy broiler litter applications on the calcium, magnesium, and potassium content in Cecil soil and the increased potential for causing grass tetany in fescue grass. Small plots of Cecil soil established in Kentucky-31 tall fescue were surface applied semi-annually for 2 years with 0, 22.4, 44.8, 89.6, and 134.4 metric tons/ha of broiler litter. Calcium wasn't leached as completely as were potassium and magnesium from the litter, even at the 134.4 metric tons/ha rate. At the highest application rate, 80 per cent of the applied calcium remained in the litter after 2 years. However, at the same rate, 99 per cent potassium and 88 per cent magnesium had been leached from the litter and presumably moved into the soil. Perhaps the most important observation made was the exchangeable calcium depletion in the profile with increased rates and between years. At the highest application rate, exchangeable calcium is evidently depleted faster than magnesium, and potassium remains the predominant cation. Imbalances in potassium, calcium, and magnesium could occur in the grass and soil under long term relatively heavy application of poultry litter to fescue pasture. These conditions may contribute to the potential grass tetany hazard in cattle grazing fescue fertilized in this manner. (Penrod-East Central)

2545-A10, B1, C3, D3

### INTEGRATED FLY CONTROL ON POULTRY RANCHES,

Division of Biological Control, California University, Riverside.
E. F. Legner, W. R. Bowen, W. F. Rooney, W. D. McKeen, and G. W. Johnston
California Agriculture, Vol. 29, No. 5, p. 8-10, May 1975. 2 fig, 1 tab.

Descriptors: Predators, Scavengers, Poultry, California.
Identifiers: Fly control, Parasites, Manure height, Manure stability.

Twelve ranches in th San Bernadino-Chino area of California were randomly selected for the study of fly control. Six of the ranches served as test ranches for supervised fly control and the other six served as controls. All twelve ranches were roofed, had no walls, and contained laying hens in suspended wire cages along concrete aisles. Routine fly control practices were already being employed on all ranches. Additionally, supervised ranches utilized a careful manure removal plan in which a minimum residual deposit of at least 6.5 inches was retained following cleaning operation in order to sustain a maximum fly predator and scavenger population and also to hasten manure decomposition. The minimum manure height that was determined to be essential for minimum fly production was 8-12 inches. Stability of the manure was found to be an important factor in integrated fly control. Seven species of flies breeding in poultry manure were significantly reduced over a twenty month period through procedures that favored the natural increase of predatory and scavenger arthropods and periodic innoculative releases of four parasitic Hymenoptera. The study indicated that there appeared to be some merit in parasitic releases that occurred during the springtime, when fly reproduction is favored through lower area density of predators and native parasites. (Penrod-East Central)

2546-A1,E1,B4,C2,D1,D3
E2,E3

### NUTRIENT CONSERVATION IN ANIMAL WASTE MANAGEMENT,

Agricultural Engineering Department, Clemson University, Clemson, South Carolina
D. T. Hill and C. L. Barth
Presented at 1975 Annual Meeting, American Society of Agricultural Engineers, University of California, Davis, June 22-25, 1975, 17 5 fig, 3 tab, 17 ref.

Descriptors: Technology, Nutrients, Nitrogen, Biological treatment.
Identifiers: Waste management, Land disposal techniques, Ensiling.

This paper discussed common waste management processes, their technological complexity, and their nutrient management characteristics. Particular emphasis is given to nitrogen control. The methods are discussed from the points of view of "existing technology" and "developing technology". Nitrogen can be managed within certain limits with existing technology. Such technology includes: ponds, lagoons, pit storage systems, oxidation ditches, and anaerobic digestion. Newly developing technology is more costly and complex to construct and operate; therefore, it can probably be justified only where large scale operation makes it economically feasible. Developing technology offers more control over nitrogen form and nitrogen loss. However, it is not possible to conserve 100 per cent of the nitrogen. Developing technology includes physical processes (such as screening), ensiling, controlled liquid biological processes, and land application techniques. (Penrod-East Central)

2547-A11,B1,D1,E2,F1,F2

### ON THE HORNS OF THE DIARY WASTE DILEMMA,

Farm advisors for LA, Orange, Riverside, and San Bernadino counties, California
F. F. Smith, S. E. Bishop, J. C. Oliver, W. C. Fairbank, W. W. Wood, Jr., and C. L. Senn
Western Dairy Journal, Vol. 31, No. 9, p. 10-13, July, 1975.

Descriptors: Dairy industry, California, Regulation, Costs.
Identifiers: Earth corrals, Recycled Aerated Manure (RAM), Pollution control.

The impact of new requirements on the Southern California Dairy industry is examined. At least eight factors have been found to influence the choice of waste management alternatives—land values (investment costs); land taxes; cow density (or manure application) limitations imposed by water control agencies; cow density limitations imposed by local governmental planning authorities; production responses attributable to the side effects of waste management facilities (heat, cold, mud, rain, etc.); operating costs; and net revenue realized from cropland used for waste disposal. A method is presented for assessing these variables. The profitability of dairying in Southern California is determined mainly by land values and pollution prevention requirements. A comparison is made of two management systems—(1) the earth corral and (2) the Recycled Aerated Manure System (RAM), in which cows are maintained in roofed, open-sided structures, with air-dried manure used as absorbent bedding. Waste management investment costs are $167 per cow and $38.50 per cow for RAM and earth corral systems, respectively. "All other costs" for the year are $780 and $775 for RAM and the earth corral, respectively. RAM provides (1) conditions for cleaner cows, (2) a more compact layout, (3) a more convenient site for examining and treating cows, (4) better udder health, (5) fewer foot or leg injuries, and (6) reduction in fly control costs. It is concluded that the RAM system offers a viable and competitive solution for waste management. (Penrod-East Central)

2548-A11, B3, C2, E3

### EVALUATION OF DEHYDRATED POULTRY WASTE AS A FEED INGREDIENT FOR POULTRY,

Department of Poultry Science, Texas A&M University, College Station
J. R. Couch
Presented at Proceedings of the 28th Annual Texas Nutrition Conference, October 3-4, 1973, p. 121-128. 17 ref.

Descriptors: Poultry, Feeds, Calcium, Phosphorus, Amino acids, Proteins.
Identifiers: Dehydrated poultry wastes, Refeeding, Energy content, Feed conversion.

The following tentative definition was adopted at the annual meeting of the Association of American Feed Control Officials, Inc.: "Dried Poultry Waste (D.P.W.) is a product composed of freshly collected feces from commercial laying or broiler flocks not receiving medicants . . . terminally dehydrated to a moisture content of not more than 15 per cent. It shall not contain any substances at harmful levels . . . be free of extraneous materials such as wire, glass, nails, etc. The product shall be labeled to show the minimum per cent protein, minimum per cent fat and per cent fiber. It may be used as an ingredient in sheep, lamb, beef and dairy cattle, broiler and layer chick feeds. Broiler and laying rations shall be limited to 20 per cent and 25 per cent D.P.W. respectively." The FDA has not yet passed approval of this product. Fecal material collected from caged poultry and not contaminated with litter can be fed to laying hens at a level of up to 25 per cent without detrimental effects. While D.P.W. has value as a source of calcium, phosphorus, and amino acids, it is low in energy and protein. D.P.W. affects feed conversion adversely on a linear basis as the level in the diet increases. While it is felt that D.P.W. will be used in feed formulations of the future, it appears to have no value for broilers. (Penrod-East Central)

2549-B3, D3, E3, F1

### SLUDGE DIGESTION OF FARM ANIMAL WASTES,

Department of Agricultural Engineering, Iowa State University, Ames
E. P. Taiganides, E. R. Baumann, and T. E. Hazen
Compost Science, Vol. 4, No. 2, p. 26-28, 1963. 2 fig, 1 tab, 12 ref.

Descriptors: Sludge digestion, Economics, Feasibility, Costs, Stabilization, Temperature, Methane.

Advantages of the digestion process for treating farm animal wastes are: (1) Organic matter is reduced 50-70 per cent, (2) Raw waste is stabilized, (3) Digested waste is thick, free-flowing, and odor-free, (4) Rodents and flies are not attracted to the end products of digestion, (5) Fertilizing constituents of the digested solids are higher than that of raw waste, (6) Commercially valuable combustible gases are produced when sufficiently high rates of digestion are maintained. Disadvantages are: (1) High initial investment, (2) Residue disposal, (3) Need for supervision of feeding the digester, and (4) Necessity of preventing intrusion of atmospheric air into the digester. Optimum digestion is obtained at 95 degrees F. The practical range of solids concentration of wastes entering the digester is 7-10 per cent. Capacity of the digester must be 10-30 times as large as the daily volume of waste digested. Sudden drops in temperature, overfeeding, and formation of a thick hard scum layer must be avoided. The value of digestion of animal wastes lies in the utilization of the methane gas and in the production of an end product that is more desirable than the raw manure. (Penrod-East Central)

2550-B2, D3, E1, E2, F1

### TREATMENT OF DAIRY WASTES BY MECHANISED BIOLOGICAL METHODS,

Scientists, CPHERI, Nagpur, India
S. R. Alagarsamy and B. B. Bhalerao
Indian Journal of Environmental Health, Vol. 14, No. 3, p. 225-235, 1972. 3 fig, 1 tab, 5 ref.

Descriptors: Waste treatment, Dairy industry, Aerated lagoons, Design, Costs.
Identifiers: India, Oxidation ditch, Mechanised biological treatment.

Because wastes from dairy plants are rich in degradable organic matter and exert a high oxygen demand, adequate treatment is necessary. The degree of treatment depends on its mode of disposal either into water courses or on to land for irrigation. Among the mechanized biological methods available, the aerated lagoon and the oxidation ditch are relatively easier to install and operate. Only partial treatment by aerated lagoon with 1.15 days detention time is sufficient for disposing the final effluent on to land for irrigation. An oxidation ditch should be used where the treated effluent is intended to be discharged into water courses. The waste treatment problem of a dairy with large capacity has been considered as a case study and detailed designs and cost studies for aerated lagoon and oxidation ditch methods have been worked out. (Cameron-East Central)

2551-B2, B3, C2, E3

### COMPARATIVE EVALUATION OF SOME TECHNIQUES USED IN DETERMINATIONS OF NITROGEN AND ENERGY CONTENT OF FECES FROM PIGS,

Department of Animal Science, Alberta University, Edmonton 7, Alberta Canada
H. S. Saben and J. P. Bowland
Canadian Journal of Animal Science, Vol. 51, p. 793-799, December 1971. 4 fig, 1 tab, 7 ref.

Descriptors: Analytical techniques, Nitrogen, Energy.
Identifiers: Swine, Feces.

Studies were undertaken to evaluate some techniques used in swine digestibility studies: (1) comparison of N content as determined on wet or dry feces from pigs fed either high or low protein diets; (2) comparison of energy content as determined on wet and dry feces; and (3) effect of length of digestion time, using the Kjeldahl method, on the determined N content of fecal material. Analysis of variance indicated no significant difference between the mean values for N content, whether determined from wet or dry fecal material from diets containing 39 or 18 per cent crude protein. The mean N loss between wet and dry determinations was .87 g/pig over the 3 day sampling period, which represents a nonsignificant 3.7 per cent N loss. No significant difference was observed between the fecal energy excreted, when analyzed in the wet or dry form. The mean energy loss was 5.0 per cent between the wet and dry material. The difference between the duplicate sample determinations never exceeded 3 per cent for N or 2 per cent for energy, but N and energy determinations on wet fecal material gave consistently greater standard errors than those on dry fecal material. These results suggest that either wet or dry fecal material may be used for N and energy determinations in pig digestion trials, without significantly influencing results obtained. (Cartmell-East Central)

2552-B2, E1

### MOST PIG WASTE DISPOSAL SYSTEMS SATISFACTORY,

Soil and Water, Vol. 10, No. 2, p. 46, December 1973.

Descriptors: Lagoons, Design, Waste disposal, Pumps.
Identifiers: New Zealand, Swine, Tanker systems.

A recent Pork Industry Council survey indicated that about 70 per cent of New Zealand's pig farms have satisfactory waste disposal systems. Areas having waste disposal problems were the Northland and the Bay of Plenty. Overloaded lagoons and inadequate pumping equipment appeared to be among major complaints. It was observed that in the future the local pig advisory officer or regional water board engineer should be involved at the design stage of a lagoon installation. It was also felt that larger pumps should be used to combat blockage problems. (Kehl-East Central)

2553-B2, C1, C2, C3, D1

### THE USE OF INDOOR LAGOONS FOR MANURE DISPOSAL IN HIGH DENSITY SYSTEMS OF POULTRY MANAGEMENT,

A. A. Al-Timimi
M.S. Thesis, Department of Poultry Husbandry, University of Nebraska, Lincoln, June, 1963, 51 p. 5 fig, 14 tab.

Descriptors: Lagoons, Poultry, Design, Sampling, Performance, Bacteria, Temperature.
Identifiers: Indoor lagoons, pH, Dry matter.

Two experiments were conducted to test and evaluate the indoor lagoon system for manure disposal under laboratory conditions. It was concluded that the primary consideration in calculating the duration of function of indoor lagoons between cleanouts is the cubage involved. It does not appear practical to aerate because no beneficial effects of aeration on dry matter accumulation were observed using 57 cc of air per minute per cu. ft. of water. Surface may be important in balancing evaporation with accumulation of solids to hold a constant level in the pit. A formula was calculated to be used where pit temperatures averaging 78.4 F are encountered. Further work is needed to relate pH, changes, nature of gases produced, and effects of other variables to details of design necessary to improve this system. (Cartmell-East Central)

2554-A5,A10,A11,A12,B1,C3,F3

### ENVIRONMENTAL HEALTH AND ANIMAL WASTES,

Texas University, Houston
J. H. Steele
Modern Veterinary Practice, Vol. 53, No. 11, p. 25-29, October, 1972. 3 fig.

Descriptors: Environmental effects, Animal wastes, Zoonoses, Vectors, E. Coli, Water pollution.
Identifiers: Anthrax, tuberculosis, leptospirosis, salmonellosis, brucellosis.

Over 100 animal diseases can be transmitted to man and many of these may be transmitted through animal wastes. This report examines the modes of transmission of several zoonoses and the effects that waste management has on their presence in livestock production units. Among the diseases discussed are: anthrax, salmonellosis, tuberculosis, brucellosis, leptospirosis and E. coli. Possible pollution of waterways with these diseases compounded by the encroachment of urban areas on agricultural zones makes livestock waste management very important in environmental health. New methods of waste management should be evaluated to ensure that they will not permit multiplication of insect and rodent vectors of disease, nor increase the animal reservoir of zoonotic diseases. Other factors to be considered in evaluating a waste management method are: (1) does it allow drainage or leaching of materials containing pathogens to a groundwater source; (2) does it constitute a means for transmitting disease from animals to man; (3) does it allow a building up, in an animal population, of levels of potentially toxic chemicals; and (4) does it support added sources of fungal contamination of the environment. Since feedlots are increasing, new methods should be developed to ensure animal health and chemical conversion to fuel oil and by-products. (Penrod-East Central)

2555-A6,A10,B1,B2,C2,D3,E2,E3,F3

### TWO TYPES OF DIGESTERS UNDER STUDY AT MSU . . .ANIMAL WASTE MANAGEMENT

Montana Agricultural Experiment Station, Montana State University, Bozeman
J. Boyd and C. Milne
Now, Spring, 1974, p. 10-11. 2 fig.

Descriptors: Aerobic treatment, Anaerobic digestion, Animal wastes, Montana, Fermentation, Odor, Nutrients, Recycling.
Identifiers: Oxidation ditch, Flies, Gas production, Refeeding, Germination cups.

The objectives of animal waste management studies carried out at the Montana Agricultural Experiment Station are: (a) study methods of odor elimination, (b) eliminate animal waste as breeding area for flies, (c) conserve the maximum nutrient content of the waste, and (d) find new ways of processed material utilization besides land application. Two systems were studied as to the effectiveness in odor elimination and conservation of waste nutrient content. The first one involved aerobic fermentation of the waste material by incorporating air into an animal waste slurry of about 10 per cent solids (oxidation ditch). The second system was an anaerobic digestion process for fermenting the waste. Because this process produced a methane-carbon dioxide gas mixture, the gas produced by one such digester was used to stir or agitate another digester, recycling the sludge in order to conserve the maximum number of digestion organisms. Through various studies, additional uses have been found for the processed waste material. They are: (1) refeeding, and (2) manure germination pots. Additional research is needed, in order to perfect the processes and make them economically feasible. (Penrod-East Central)

2556-A3,A8,B2,C2,D3,E2,E3,F3

### WATER QUALITY AND SOIL EROSION FROM SURFACE APPLICATION OF TREATED LIQUID SWINE WASTE,

R. W. Gunther
MS Thesis, Agricultural Engineering Department, University of Illinois, Urbana-Champaign, 1974, 82 p. 5 fig, 31 tab, 23 ref.

Descriptors: Water quality, Soil erosion, Agricultural runoff, Liquid wastes, Waste disposal, Percolating water.
Identifiers: Land disposal, Swine, Soil solids, Universal soil loss equation.

Waste products disposal is a problem faced by both rural and urban people. Because of stricter regulation and the limited technology and capital available to meet these standards, these groups are giving more consideration to land application of wastes. This study's objectives were: (1) study the quality of runoff and percolate from a rainfall event on soil which has received various applications of treated liquid waste; (2) investigate waste application effects on soil erosion; (3) develop a manure erodibility factor and a soil erodibility factor to use in the universal soil-loss equation, for a soil that has had treated liquid waste applied on the surface. The procedures for the study are given. The following conclusions were drawn: (1) Although the percolate had high nitrate concentrations, the percolate from manured soils was of better quality than the runoff; (2) the application of liquid swine waste on soil caused an increase in percolation through the soil that corresponded to the decrease in runoff from a rainfall event; (3) volatile solids were more easily eroded than non-volatile solids; (4) because of the decreased volume of runoff and the surface stabilization effect of waste, and therefore, the decreased COD load placed on the stream, runoff from soils that have had liquid wastes applied to them may be less of a pollution hazard to streams than runoff from bare soil; (5) a new slope length factor was determined for a three foot slope length for the universal soil-loss equation; and (6) as compared to runoff from bare soil, runoff from soils where liquid waste had been applied contained fewer soil solids. (Kehl-East Central)

2557-A5,A8,B2,B3,C2,E2,F1

### LAND AND CROP UTILIZATION OF ANIMAL MANURE AT FIVE MINNESOTA LOCATIONS,

North Central Experiment Station, Minnesota University, Grand Rapids
P. R. Goodrich, J. J. Boedicker, E. C. Miller, J. D. Evans, and G. W. Randall
Presented at 1973 Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-430, 16 p. 16 tab.

Descriptors: Minnesota, Crop response, Chemical analysis, Soil analysis, Nutrients, Salts.
Identifiers: Land disposal, Application rates.

Manure was used as fertilizer on various experimental plots in Minnesota in an attempt to investigate the problems associated with the application of manure. The investigation was aimed at lowering hauling costs and protecting soil productivity, groundwater quality, and crop yields. Extensive soil and manure samples were analyzed for total nitrogen, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, conductivity, chlorides, potassium, sodium, and pH. Emission spectograph analyses were performed on manure samples for phosphorus, potassium, calcium, aluminum, sodium, iron, magnesium, zinc, copper, molybdenum, manganese, and boron contents. Three types of manure were applied in the fall of 1970 and again in the fall of 1971: solid beef manure at 100 tons-acre, liquid beef manure at 284 tons/acre, and liquid hog manure at 284 tons/acre; the fertilized plots were planted with corn in 1971, 1972, and 1973. The following observations were drawn from this study: (1) Although there were some mechanical problems, it was found that manure can be successfully applied at these rates. (2) At these rates of manure application, the plant food application rate was quite high. (3) The high salt content in the manure increased soil conductivity, but only damaged plants receiving the liquid beef manure. (4) Yields from plots receiving manure were not statistically different from plots receiving inorganic fertilizer. (5) Though manure applications increased nitrate-nitrogen and chloride levels in the soil, there was no apparent movement of nitrate-nitrogen below three feet. (Sanders-East Central)

2558-A11, B3, E3

### CHICKEN LITTER AS A SUPPLEMENT IN WINTERING BEEF COWS AND CALVES ON PASTURE,

M. L. Ray and R. D. Child
Arkansas Farm Research, Vol. 14, No. 4, p. 5, July-August, 1965. 3 tab.

Descriptors: Litters, Feeds, Cattle, Performance.

In 1964, a cooperative experiment was initiated to study methods of feeding chicken litter to lactating beef cows. 120 brood cows were divided into four units of 30 head each. The rations fed were: Group I-Litter free choice plus all the hay that would be cleaned up before the following day; Group II-Free choice hay only; Group III-Litter that cows and calves would clean up in two hours plus all the hay they would clean up in 24 hours; Group IV-Free choice litter only. All the calves were creep fed. Each group was kept on a high quality stand of tall fescue which furnished considerable grazing throughout the wintering period. Weights, grades, and condition scores were recorded for the cows and their calves on December 1, 1964, when the test started and again on April 15, 1965, when the test ended. Daily feed intake was recorded by groups. Groups ranked by weight loss (from greatest to smallest) were II, I, IV, and III. Groups ranked by weight gains of calves (from greatest to smallest) were III, IV, I, and II. The calves in group IV were as bloomy as those in the other groups and the cows evidently produced as much milk as cows in the other groups. Study results indicate that cow herds can be wintered economically on Kentucky 31 fescue pastures supplemented with broiler house litter and an energy source without any expectation of harmful effects on the cows or calves. (Merryman-East Central)

2559-A2, B2, B3, B4, E2

### COMPARISON OF DESIGN CRITERIA AND PERFORMANCE OF WASTE HANDLING SYSTEMS,

Agricultural Engineering Department, Michigan State University.
T. L. Loudon, R. L. Maddex, and C. H. Shubert
Presented at 1975 Annual Meeting, American Society of Agricultural Engineers, University of California, Davis, June 22-25, 1975, 14 p. 2 tab, 1 ref.

Descriptors: Design criteria, Michigan, Performance, Dairy industry, Cattle, Agricultural runoff.
Identifiers: Waste handling systems, Swine, Land disposal.

A research study is under way in Michigan to evaluate animal waste handling systems on 24 dairy, beef, and swine farms. In some instances the complete system is being studied, while in other instances only a specific component of the system is under study. Data collection is performed by both the farmer and the project personnel using basic instrumentation for measurement of precipitation, manure level in storage facilities and temperatures in selected manure storage facilities. Manure storage facilities and runoff retention ponds are receiving particular attention, comparing design expectations with actual land application, and handling method. Observations that have been made may be summarized as follows: (1) Few manure storage facilities function exactly as planned. A common area of discrepancy between design and performance is the storage period achieved. (2) A storage facility designed for both manure and runoff is difficult to manage if the only land application method is a liquid manure spreader. (3) Hauling manure from a concrete bunker storage facility which doesn't provide for draining liquids away is not feasible with a conventional loader and spreader. (4) Total waste production in a farrowing building including washdown waste water averages 1.17 $ft^3$/sow/day. (5) The best times to empty manure storages in Michigan are during winter or after hay harvest. (6) Peak labor demands for waste handling may be considered second priority if cropping programs labor demands are high. (7) Michigan farmers apparently consider management of runoff ponds as a low priority item. (Penrod-East Central)

2560-B3, C2, C3, D2, E3

### COLORADO DPW PROCESSING FIRM FINDS READY MARKET AS BOTH FEED, FERTILIZER,

B. M. Wilkinson
Feedstuffs, Vol. 47, No. 33, p. 7, August 18, 1975. 3 fig.

Descriptors: Colorado, Poultry, Feeds, Fertilizers, Dehydration.
Identifiers: Dried poultry waste.

A new dried poultry waste (DPW) processing plant in Colorado began operations in March and since has been having difficulties just keeping up with demand for DPW. The waste is being sold to feed manufacturers for as high as $72 a ton, according to Stanley K. Hill, Vice-president of Organic Products, Inc., the DPW firm. Sunnymead, the poultry farm supplying this plant, is expected to make $18,000 to $20,000 annually from the DPW. The cost of establishing the DPW plant was under $200,000. The DPW is also being marketed as fertilizer under the brand name TIARA in order to keep the plant operating in slack feeding periods. The cattle don't seem to mind DPW in their feeds, although one feedlot reported rejectance when DPW was abruptly added in place of a familiar ingredient for 6 per cent of the total ration. Hill advises that DPW be added gradually to the ration. The biggest problem with DPW is drying it; the fresh manure is about 75 per cent moisture, and needs to be around 40 per cent moisture before dehydration is economical and efficient. Fans are used to aerate the DPW before dehydration. The temperature in the drying chamber is kept at about 275 degrees. This is high enough to kill pathogens yet low enough to save nitrogen and micro elements. (Sanders-East Central)

2561-A4,A5,A6,A7,B1,E2,
F1,F2

### WASTE MANAGEMENT PRACTICES AND SYSTEMS ON MICHIGAN DAIRY FARMS,

Department of Agricultural Engineering, Michigan State University, East Lansing
C. R. Hoglund, J. S. Boyd, L. J. Connor, and J. B. Johnson
Agricultural Economics Report No. 206, Department of Agricultural Economics, Michigan State University, January, 1972. 15 p. 6 tab.

Descriptors: Michigan, Regu[illegible]n, Dairy industry, Water pollution, Air pollution, Costs.
Identifiers: Waste management.

A survey was conducted in Southern Michigan to collect information concerning manure handling systems, practices, and costs on dairy farms having different herd sizes and housing systems. The information was collected in order to provide a basis for developing investment and cost data for alternative manure handling systems which would take into account varying degrees of air and water pollution control that would be required by the Michigan Water Resources Commission and/or the Michigan Air Pollution Control Commission. The following conclusions were drawn from the 314 surveys that were completed and returned. Dairy housing and manure handling systems were related to herd size, which ranged from 46 cows on farms with stanchion housing and a gutter cleaner-spreader manure handling system to 135 cows on farms with a covered housing/liquid manure handling system. The largest herds, averaging 158 cows, used open-lot housing and liquid manure systems. Acres of cropland on which manure was spread ranged from 4 acres per cow on those farms with stanchion housing to 3 acres per cow on farms with covered housing-liquid manure systems. Most dairymen stated that they had received no strong objections from neighbors about odors from their manure handling systems even though approximately half of them reported a neighbor within one-half mile. Investments in the complete waste management systems ranged from $80 to over $190 per cow, depending on the sophistication of the system. (Sanders-East Central)

2562-B2,B3,C1,C2,C3,F1,
F3,F6

### RESEARCH AND PRACTICE IN ANIMAL WASTES TREATMENT,

Tippecanoe Laboratories of Eli Lilly and Co., Lafayette, Indiana
R. H. L. Howe
Water & Wastes Engineering, Vol. 6, p. A14-A18, 1969. 4 fig, 7 tab, 6 ref.

Descriptors: Animal wastes, Waste treatment, Regulation, Research and development, Coagulation, Stabilization, Activated sludge, Lagoons, Oxidation.

Because of stricter pollution regulations and the need of producing more food to meet the needs of a growing population, the problem of animal and dairy wastes has been intensified. The purpose of this study is to present research and developmental work conducted by the author and his colleagues. In the feeding industry, animal wastes are defined as including: waste feed, excreta, bedding material, washings, and spills. Among research in wastes disposal methods, the Institute of Advanced Sanitation Research, International has initiated a cooperative project, involving several member-scientists, primarily for the investigation of the characteristics of various animal wastes before and after treatment. The author states that it is their finding that solid wastes and liquid wastes must be separated and handled differently for reasons of economy. Also being investigated are physical and chemical methods of animal wastes treatment. The search for an economical coagulant has led the author and his colleagues to develop a very promising inorganic polymeric coagulant which has been tested in plant-scale operation. Animal processing wastes vary in terms of their characteristics. The main problems in treating these wastes are caused by: blood, color, solids, BOD, grease, hairs, and proteinaceous particles. In treating animal processing wastes, effective and proper methods of stabilization are needed. Several methods of stabilizing biological sludge and dairy wastes are given. The author discusses various research needs. Mr. Howe says that it is believed that segregation of strong wastes from weak would be appropriate. (Penrod-East Central)

2563-A2,A5,A7,A8,B2,C2,
E2

### SOME EFFECTS OF BEEF FEEDLOT EFFLUENT APPLIED TO A FORAGE SORGHUM,

J. E. Sukovaty
Unpublished MS Thesis, University of Nebraska, May, 1973, 61 p. 13 fig, 13 tab, 41 ref.

Descriptors: Agricultural runoff, Feedlots, Crop response, Sorghum, Nutrients, Effluent, Waste disposal, Legislation.
Identifiers: Land disposal, Detrimental effects.

An increased food need has caused increased beef production, resulting in an increase in feedlots. The animal wastes from these facilities present potential runoff, groundwater and air pollution problems. Legislation has stated that runoff must be collected. Once this is done, it must be disposed of properly. Before effluent disposal on cropland is recommended, several questions should be answered. Such questions encompass nutrient value, detrimental effects of the effluent, and possible soil pollution problems. Data analysis obtained for a two year effluent disposal study revealed definite treatment differences between effluent and water applications. High rates of effluent application were observed to have an additive effect on $NO_3$-N concentrations in harvested plants for 1972. Such an effect was not observed for 1971. The addition of phosphorus to the surface four inches of soil was linearly related to increasing effluent application over the two year period. Effluent addition to cropland showed an increase in soil solution of Na, Ca, and K. Data from the two year study indicate the 1-inch effluent application appeared to have the most beneficial results. Other than an increase in P accumulation, the addition of 2-inches of effluent per week did not show beneficial results over the 1-inch effluent application. The study concluded that negative yield response may be offset by the increase efficiency of waste disposal. Points that should be considered if this type of disposal is used are: (1) nutrient and salt concentrations in effluent, (2) soil texture and area of available land, (3) local precipitation and climatic factors, and (4) size of operation. (Penrod-East Central)

### 2564-A5, A8, B1
### PHYSICAL CHARACTERISTICS OF THE SURFACE AND INTERFACE LAYERS OF A LEVEL BEEF CATTLE FEEDLOT,

L. N. Mielke
PhD Dissertation, Nebraska University, Lincoln, April, 1974, 166 p. 14 fig, 49 tab, 77 ref.

Descriptors: Cattle, Permeability, Sampling, Soil profiles, Groundwater pollution.
Identifiers: Feedlot surface, Interface layer, Organic materials, Inorganic materials, Soil cores.

The object of this study was to measure the physical changes that occur in soil under the influence of a beef cattle feedlot. Special emphasis was given to the interface zone formed between the inorganic and organic material near the soil surface. A soil sampling technique was developed using heat-shrink plastic tubing to encase undisturbed cores. The cores obtained were very adequate for laboratory study of the soil conditions beneath the feedlots. Water movement into the profile was greatly restricted by the combination of animal wastes and cattle tramping. This action also increased the bulk density of the top 15 to 20 cm of the profile and caused the formation of a boundary or interface layer between the organic and inorganic materials. Mixing of soil and organic matter occurred below and above interface boundary that was formed. The interface layer influenced the movement of air, water and nutrients into the soil profile and into the groundwater. Other soil cores from the cropland and feedlot were segmented into sections about 10 cm long. Observations of these sections are given. Chemical analysis of percolate from the soil sections showed the highest concentration of Na and K in the interface layer. The dispersing effect of Na and K in the soil together with the compaction by hoof action resulted in a very poor physical condition at the feedlot soil surface that limited the movement of water and air. (Penrod-East Central)

### 2565-A2,A4,A5,A6,A7,A10,A11,B2,B3,D1,D2,D3,E2,E3,E4
### SANITARY ENGINEERING IN AGRICULTURE,

Department of Agricultural Engineering, California University, Davis
S. A. Hart
Transactions of the Fourteenth Annual Conference on Sanitary Engineering, The Bulletin of Engineering and Architecture No. 52, The University of Kansas, Lawrence, 1974, p. 5-10. 8 fig, 15 ref.

Descriptors: Drying, Oder, Lagoons.
Identifiers: Agricultural wastes, Waste management, Composting, Land disposal.

Depending on the definition used, there are four or five kinds of agricultural wastes: (1) livestock manures, (2) crop residues, (3) dead animals, (4) agricultural chemicals, and (5) runoff water and eroded soil. Livestock manure is the agricultural waste that creates the greatest problem today. Manure cannot usually be allowed to accumulate in a confinement area until use, because of the sanitation hazards of odors, dust, animal health, fly breeding, or potential water pollution. Therefore, four steps need to be considered in manure management—collection, processing, storing, and utilization. The form of the waste (liquid or solid) determines the type of waste management practices utilized. Manure processing is based on the stabilization of a waste organic matter which is contaminated with water. Drying and composting as stabilizing processes are examined. Processing methods for liquid-carried manure include: digestion, anaerobic lagooning, and possibly aerobic treatment akin to the activated sludge process. The main emphasis on storing manure is that it must be sanitary. Stabilization is very important in preparation for storage. Manure may be disposed of or utilized in several ways, the main method being land application. Other uses are in experimental stages and include (1) recovery of drugs, vitamins, and hormones from the wastes, and (2) use of livestock wastes as a source of fuel. (Penrod-East Central)

### 2566-B2, D1, D3, E2
### NEWER ASPECTS IN TREATMENT OF PACKING HOUSE AND FEEDLOT WASTES,

Oscar Mayer and Co., Madison, Wisconsin
A. S. Johnson
Transactions of the Fourteenth Annual Conference on Sanitary Engineering, The Bulletin of Engineering and Architecture No. 52, The University of Kansas, Lawrence, 1964, p. 10-18. 7 fig, 4 tab, 6 ref.

Descriptors: Waste treatment, Waste disposal, Wisconsin, Feedlots, Farm wastes, Trickling filters, Lagoons, Waste water treatment.
Identifiers: Packing house wastes, Anaerobic stabilization ponds, Composting.

Attempts are being made in Wisconsin to improve the efficiencies of processes utilized in treating packing house wastes. Primary treatment usually includes various combinations of screens, flocculators, sedimentation tanks and dissolved air flotation tanks. Some plants operate trickling filters of packing house waters, for secondary treatment. Other plants use anaerobic stabilization ponds, sometimes in conjunction with trickling filters. The problem of feedlot waste disposal has not to date been subject to review by the Wisconsin Water Pollution Commission, although feedlots are becoming a larger industry in the state. Although return of manure to the soil is still the principal disposal method, improvements in handling facilities and attempts to apply anaerobic ponds to treatment of the wastes appear to be the primary trends in this area. (Penrod-East Central)

### 2567-A2, A4, B1, C2
### STREAM POLLUTION FROM FEEDLOT RUNOFF,

Environmental Health Services, Kansas State Department of Health, Topeka
S. M. Smith and J. R. Miner
Transactions of the Fourteenth Annual Conference on Sanitary Engineering, The Bulletin of Engineering and Architecture No. 52, The University of Kansas, Lawrence, 1964, p. 18-25. 7 fig, 8 tab.

Descriptors: Water pollution, Agricultural runoff, Feedlots, Kansas, Atmospheric precipitation, Ammonia.

The objective of this report is to indicate that the authors' findings show animal feedlot runoff to be a significant source of water pollution, and to present data which have been collected indicating the nature of the pollution and the behavior of streams after being subjected to this type of pollution. The limited amount of information that seems to be available describing stream pollution may be partly accounted for by the problem of collecting stream samples during or shortly after runoff. The principal data for this Kansas study came from water samples collected from three streams—the Whitewater River near Potwin, the Cottonwood River near Emporia, and Fox Creek near Strong City. The nature of such runoff pollution is described as follows: (a) runoff imposes a slug load on the stream, (b) feedlot runoff is high in ammonia and the resulting stream pollution shows characteristic high ammonia concentration, and (c) a high bacterial population is produced by the runoff. Serious dissolved oxygen content depletion may occur in the stream if the stream is small and the waste load is large. The degree of stream pollution is dependent on a variety of factors: feedlot size, lot cleanliness at time of runoff, area topography and lot location with respect to receiving waters, rainfall intensity, amount and pattern, stream size, and the pollution control measures used. (Penrod-East Central)

### 2568-B3,B5,C1,C2,D2,E3
### THE EFFECT OF DEHYDRATION ON THE CHEMICAL COMPOSITION AND NUTRITIVE VALUE OF MANURE,

C. W. Berg
MS Thesis, Agricultural Engineering Department, North Dakota State University, Fargo, September, 1972, 77 p. 25 fig, 11 tab.

Descriptors: Dehydration, Chemical properties, Nutrition, Dairy industry, Cattle, Moisture content, Temperature.
Identifiers: Manure.

An investigation was conducted to determine the effects of drying air temperature, final moisture content and accumulation time on the chemical composition of the dried manure product. Investigators hoped to establish any trends on the chemical composition and nutritive value of the dried manure product that might be caused by the various treatment effects. Manure was collected from dairy steers and consisted of samples which had accumulated for different time periods. The manure was dried down to three different final moisture contents at four temperature levels. The chemical composition of the manure was then determined to obtain the nutritive value of the dried manure product. It was concluded that: (1) Ash, acid detergent fiber, lignin, cell wall constituents, silica, phosphorus, potassium, calcium, and magnesium revealed higher dry weight percentages in the manure than in the feed consumed; (2) An increase in manure accumulation time revealed an increase in dry weight percentages of ash and silica and a decrease in protein; (3) Cell wall constituents increased with increase in final moisture content; (4) Generally, increase in temperature caused an increase in dry weight percentages of silica, fiber lignin, and phosphorus. However, as temperatures increased the amount of cell wall constituents and digestible dry matter decreased; (5) Drying to 1 per cent final moisture content at 200 degrees C gave the highest dry weight percentages and contributed greatly to significant differences of the temperature by final moisture content interaction of ash, silica, fiber, lignin, phosphorus, potassium, and magnesium; (6) Optimum drying conditions would call for collection of manure daily and, if possible, drying it at 100 degrees C to a final moisture content of 8 per cent. (Cameron-East Central)

### 2569-A8, C2, E2

## RATE OF MANURE DECOMPOSITION IN SOIL AND EFFECTS OF SPRINKLER APPLICATION OF LAGOON EFFLUENT ON CORN AND GRAIN SORGHUM,

T. E. Loynachan
MS Thesis, Department of Agronomy, Iowa State University, 1972, 81 p. 7 fig, 23 tab, 84 ref.

Descriptors: Crop response, Sprinkler irrigation, Carbon dioxide, Phosphorus, Nitrogen, Potassium, Salinity.
Identifiers: Land disposal, Decomposition, Anaerobic lagoons, Swine.

The main objective of this study was to consider soil as the ultimate medium for manure disposal. Two methods were investigated: (1) application of the complete manure to the soil, and (2) the anaerobic lagooning of the fresh manure followed by application of the effluent to land. In experiment I, hog manure was applied to Webster clay loam soil at the rates of 0, 10, 50, 100, and 200 parts wet manure per thousand parts dry soil. The relative rates of manure decomposition were found to be inversely related to quantity added, while the absolute rates were found to be directly related to the quantity added. Carbon dioxide production rate increased to a peak within two days and then gradually decreased. Rate of and total carbon dioxide evolution were more closely related to amount of carbon added than to moisture level. Results indicated that no more than 100 tons per acre of manure should be applied at any one application to similar soils. In experiment II, swine-lagoon effluent was applied to land growing corn and grain sorghum. Effluent was sprinkler irrigated at rates of 0-17.09 inches from June 21 to August 27, 1971. The effluent had no significant effect on corn yield; however, grain-sorghum decreased up to 53 bushels per acre. Higher rates of effluent application induced lodging of the grain-sorghum heads. Protein in the grain increased with increasing rates of effluent on grain sorghum, but this trend was not observed in corn. Increasing amounts of applied effluent caused increased values of extractable phosphorus and exchangeable potassium in the surface two inches of soil. Salinity also increased. (Penrod-East Central)

### 2570-A10.A11.A12,B4.C3

## BIOCONCENTRATION AND BIOTRANSFER OF AFLATOXIN,

Department of Microbiology, Colorado State University, Ft. Collins
M. P. Nevins and D. W. Grant
Bulletin of Environmental Contamination and Toxicology, Vol. 6, No. 6, p. 552-558, November-December, 1971. 17 ref.

Descriptors: Microorganisms, Toxicity, Feedlots, Cattle, Fish, Health.
Identifiers: Bioconcentration, Biotransfer, Aflatoxin, Substrate, Flies.

Research was undertaken to isolate aflatoxin-producing strains of Aspergillus flavus from manure and to demonstrate a potential path for the biotransfer and biomagnification of the aflatoxins in a simulated food chain. It was found that toxigenic strains of A. flavus can be readily recovered from stockpiled feedlot manure and that, under certain conditions, aflatoxin production within the manure can occur. Since the manure is attractive to several species of ovipositing flies, notably Musca domestica, ample opportunity exists for the biotransfer of the aflatoxin from the manure into the insect larvae. Maggots can convert the manure substrate into their biomass with an efficiency of 71 per cent, after which the toxicity of the substrate increases. When this maggot-bioconcentrated crude aflatoxin was ingested by trout, severe aflatoxicosis was evident in the fish within 10 days. It is likely that, although trout would have little access to toxic maggots, the fish could receive carcinogenic doses via ingestion of the flies developed from toxic larvae. Based on the results of this study, it appears that serious environmental health problems could develop from the biotransfer and bioconcentration of aflatoxins originating in stockpiled manure. The problem is probably most prevalent in agricultural areas with favorable high temperatures and humidities. (Solid Waste Information Retrieval System)

### 2571-A1,A4,A5,A6,A7,A10,F2

## LEGAL IMPLICATIONS OF FEEDLOT POLLUTION IN NEBRASKA,

Nebraska University-Lincoln College of Agriculture, The Agricultural Experiment Station.
D. C. Nelson
Publication SB 529, Agricultural Experiment Station, University of Nebraska, Lincoln, 24 p.

Descriptors: Legal aspects, Feedlots, Nebraska, Nuisance, Negligence, Trespass, Common Law, Odor, Dust, Water pollution.
Identifiers: Noise, Pests.

The common law and statutory legal implications of feedlot pollution in Nebraska are examined. The fundamental inquiry in Nebraska is to determine whether the feedlot operation violates the accepted rule of decency and substantially depreciates the value of the nearby property. The judicial precedents of such inquiry are discussed in terms of odor, dust, noise, water contamination and pests. The common law theories of nuisance, negligence and trespass are examined. Statutory measures are also discussed and suggestions are made for ways to reduce the chances of legal suits against feedlots due to pollution. (Penrod-East Central)

### 2572-A6,A10,B3,B4,C2,E1

## THE DRY DEEP PIT SYSTEM,

Purdue University
R. L. Adams
Poultry Tribune, Vol. 77, p. 26, 28, April, 1971. 2 fig.

Descriptors: Poultry, Odor, Water pollution, Ventilation.
Identifiers: Deep pits, Flies.

Odors, flies, and nutrients in water courses are the typical pollution problems associated with poultry. All can be eliminated by use of a deep (8 to 10 ft.) pit under the poultry house if it is kept dry. Install and maintain a proper watering system. Mechanical ventilation will be required for high-density chicken populations. The pit may never require cleaning. (Whetstone, Parker, & Wells-Texas Tech)

### 2573-F2, F4

## A LIVESTOCKMAN'S GUIDE TO POLLUTION LAWS,

Special Features Editor, Successful Farming
R. Lutz
Successful Farming, Vol. 70, p. 42-43, 50, October, 1972. 1 fig.

Descriptors: Legal aspects, Regulation, Feedlots, Water pollution, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin.

Laws are outlined for the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Addresses of Agencies charged with supervision of agricultural pollution in the 12 states are included. (Whetstone, Parker, and Wells-Texas Tech)

### 2574-A11, B2, F2, F3

## METHODS AND PROBLEMS RELATING TO DISPOSAL OF WASTES FROM LIVESTOCK MARKETS,

H. F. Mayes
Presented at 66th Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-401, 11 p. 6 fig.

Descriptors: Waste disposal, Livestock, Regulation, Design.
Identifiers: Hydraulic cleaning, Sanitation requirements.

Livestock markets have experienced problems in disposing of waste materials since the late 1940's. The two main species of livestock handled by most markets are cattle and swine. Design engineers need data on waste produced by each of these species. The amount of water used in hydraulic cleaning of wastes at market facilities is also needed. This data is essential if efficient waste treatment systems are to be designed for livestock markets. Research must supply this information since reference literature is not available. All of the market facilities are under the regulations of the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture and the respective State Veterinary's office. These animal health requirements specify daily cleaning of specific facilities. (Cartmell-East Central)

### 2575-A2, B2, B4, E2, F1

## HE USES VALUABLE RUNOFF,

Successful Farming, Vol. 73, No. 8, p. H10, June-July, 1975. 1 fig.

Descriptors: Agricultural runoff, Drainage, Feedlots, Fertilizers, Costs.
Identifiers: Waste collection, Land disposal.

Bob Atherton's Earlville, Illinois feedlot has undergone a number of low-cost alterations over the years in order to eliminate muck and runoff problems on his cement feedlot. Atherton's feedlot is 96' x 110' with a capacity of 350-375 head of cattle. The lot has an 8-10" slope toward the middle. From here, liquids drain into a center outlet and buried tile and are carried to a 6' x 8' x 110' pit along the front of the lot. This pit collects nearly all the liquid runoff, including some loose manure. Atherton empties the pit about six times a year by means of a liquid spreader with a vacuum pump. A conventional loader handles the remaining solids. During winter months, Atherton tries to keep the pit about two-thirds full to prevent damage to the pit that might be caused by freezing and thawing if left empty. The system seems to work very well. A drier lot, drier bedding, and less required labor have resulted in an economic savings over Atherton's original system. Final alterations for this lot cost $2,500, only about $7 per head capacity. (Cameron-East Central)

### 2576-A5, F4

## POLLUTED GROUNDWATER: A REVIEW OF THE SIGNIFICANT LITERATURE,

TEMPO, General Electric Company Center for Advanced Studies, Santa Barbara, California
D. K. Todd and D. E. McNulty
Environmental Protection Agency Report Number EPA-600-4-001, March, 1974, 215 p. 661 ref.

Descriptors: Groundwater pollution, Bibliographies, Water pollution sources, Underground waste disposal, Aquifer Management, Waste disposal wells, Saline water intrusion, Path of pollutants.

A selective review is presented of the literature on man-caused groundwater pollution, including causes and occurrence, procedures for control, and methods for monitoring. No attempt was made to develop a comprehensive bibliography on the subject. Rather, references were selected for inclusion on the basis of their significance and relevance. Bibliographies, important general references, abstracts, and European references are discussed separately. Thereafter the literature is described in essay form on a subject basis. References cited by number in the text are listed in complete bibliographic form at the end of the report together with an author index. With few exceptions, the material reviewed is limited to relatively recent published items in the United States. Administrative regulations, legal reports, and unpublished materials such as theses have been omitted. (Environmental Protection Agency)

**2577-A8, C2, E2**

## RATE AND EXTENT OF NITROGEN AND PHOSPHORUS MOVEMENT THROUGH GLACIALLY DEPOSITIED SOILS TREATED WITH POULTRY MANURE,

R. A. Hoffman
MS Thesis, Department of Agronomy, University of Maine, Orono, June, 1973, 169 p. 9 fig, 42 tab, 111 ref.

Descriptors: Nitrogen, Phosphorus, Soils, Infiltration, Poultry.
Identifiers: Land disposal.

The objective of this study was to monitor the movement of ammonium, nitrate and phosphate ions in the soil water solution as influenced by the incorporation of poultry manure into the plow layer. Soil samples were collected for analysis of selected chemical properties. There was some variability in the results because of missing samples and seasonal fluctuations. Provided available soil moisture was present and the vacuum was applied within 48 hours prior to water sample collection, the porous ceramic cup technique was an adequate means of extracting soil water from a soil profile. The soil water solution collected increased in $NH_4$-N and $NO_2$-$NO_3$-N concentration, presumably due to the manure applied. The level of $NH_4$-N, $NO_2$-$NO_3$-N and $PO_4$-P in the ground water table in the Windsor loamy sand was not significantly increased by manure applications during the study period. There was a significant increase in the $NH_4$-N and $NO_2$-$NO_3$-N concentration on top of the fragipan within the treatment plots on the Charlton fine sandy loam. During the study the total soil nitrogen and the organic matter analyses indicated little change resulting from manure application. (Penrod-East Central)

**2578-A8, C2, E2**

## NITROGEN TRANSFORMATION AND MOVEMENT IN A MARINE SEDIMENT SOIL FOLLOWING TREATMENT WITH VARYING RATES OF POULTRY MANURE,

R. F. Jeffrey
MS Thesis, Department of Agronomy, University of Maine, June, 1972, 124 p. 17 fig, 29 tab, 84 ref.

Descriptors: Poultry, Leachates, pH.
Identifiers: Nitrogen transformation, Nitrogen movement, Marine sediment soil, Land disposal, Application rates.

The purpose of this study was to determine the transformations and movement of nitrogen through a marine sediment soil following application of poultry manure at rates of 0, 200, 400, 800, and 1600 pounds of nitrogen per acre per year. A Scantic soil was treated three times over a nine-month period with five levels of nitrogen in the form of poultry manure. The resulting leachate and soil were analyzed for selected microbiological and chemical properties. Soil microorganisms, Nitrosomonas, Nitrobacter, and the denitrifiers tended to increase under all treated plots in comparison to the control. The population levels for the two nitrifiers were greatest in the A horizon while the denitrifiers were greatest in the B horizon. Greater than 90 per cent of the original or applied nitrogen was accounted for upon evaluation of all incoming and outgoing sources of nitrogen. The greatest treatment, 1600 pounds nitrogen per acre per year, lost the greatest amount. In the A horizon, total soil nitrogen increased as treatment rate increased. Also as treatment of nitrogen increased, the easily oxidizable organic matter showed an increase in the upper two horizons. Under the two highest treatments, 800 and 1600 pounds of nitrogen per acre, a considerable decrease in pH took place at all depths. (Penrod-East Central)

**2579-B2, C3, D3, E2**

## MICROBIOLOGY IN THE AEROBIC TREATMENT OF FARM WASTES,

J. M. Grainger
Process Biochemistry, Vol. 8, No. 3, p. 28-30, March 1973. 28 ref.

Descriptors: Microbiology, Aerobic treatment, Research and development, Sampling, Microorganisms, Design, Waste treatment.

Microbiology is making an increasing contribution to research work on farm waste problems in relation to treatment systems and the consequences of disposal of treated and untreated slurry to land. A necessary contribution is the study of factors which influence growth and activities of microorganisms, the results of which can be valuable in designing and operating treatment systems. It is essential that studies be done with cultures that are adequately representative of those microorganisms whose activities are important in the treatment process. Consequently this article examines some procedures for the enumeration and isolation of heterotrophic microorganisms, of aerobic systems for treatment of farm slurry. The projects being studied concern cattle slurry treatment by an oxidation ditch, treatment of poultry manure by a biological filter, and the disposal of heavy dressings of cattle slurry to grassland. The microscope may be used for observing the colony and its isolates. Accurate isolation of bacteria representative of that in the treatment system is dependent on (a) handling of sample before examination in the laboratory, (b) dilution and homogenization, (c) composition of isolation medium, (d) method of inoculating the isolation medium, and (e) temperature and period of incubation. Each of these procedures is examined in detail. (Merryman-East Central)

**2580-A8,B4,C2,D3,E2,F1**

## THE TREATMENT OF LIVESTOCK WASTES.

Scottish Farm Buildings Investigation Unit, Aberdeen
A. M. Robertson
Process Biochemistry, Vol. 7, p. 21-25, June 1972. 7 fig, 6 tab, 7 ref.

Descriptors: Livestock, Waste treatment, Feedlots, Confinement pens, Physical properties, Chemical properties.
Identifiers: Land disposal, Scotland, Loading rates, Oxidation ditch, Anaerobic lagoons, Liquids solids separation, Surface aerator.

Because in the future livestock will be produced in feedlots and confinement pens of increasing size, increased technology and knowledge will be needed for animal waste management. Factors influencing animal waste properties are species, feeding, environment, and liveweight. While land disposal is still a desired means of animal waste disposal, overfertilization due to excessive nutrients in the soil is making researchers take a long hard look at land disposal. Land spreading should be avoided when soil temperatures are less than 4.4 degrees C. Spreading rate should at times be lower than the instantaneous infiltration capacity of the soils and should never be so heavy that it forms an impermeable cap. Maximum amounts to be spread should be determined by permissible hydraulic and chemical soil loading rates. In addition, it may be necessary to improve waste handling qualities before land disposal through biological treatment. Examples of such treatment may be found in the examination of Aberdeen's experiment utilizing oxidation ditches, surface aerators, and anaerobic lagoons. A theoretical assessment of the likely application of the waste treatment systems described is given along with suggested theoretical relationships between investment costs in the treatment plant, etc., and the level of treatment achieved. (Merryman-East Central)

**2581-A12,A13,B4,C2,D3,F1**

## ANAEROBIC DIGESTION OF HOG WASTES,

Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa
E. P. Taiganides, E. R. Baumann, H. P. Johnson, & T. E. Hazen
Journal of Agricultural Engineering Research, Vol. 8, No. 4, p. 327-333, 1963. 5 fig, 9 ref.

Descriptors: Anaerobic digestion, Sludge digestion, Methane, Carbon dioxide, Nitrogen, Design criteria.
Identifiers: Swine, Detention period, Volatile solids, Gas yield, Fertilizer value.

From the viewpoint of aesthetics, economics and public health, farm wastes should be given a treatment that will stabilize the manure, remove its nuisance characteristics, sustain its fertilizer value and reduce the pollution properties of the manure to a safe level before final disposal. Although there are a number of such treatments, the objective of this study was to examine the anaerobic sludge digestion process and report the results of a laboratory study on the application of sludge digestion for the treatment of swine wastes. The laboratory study showed that at 95 degrees F, hog wastes were digested satisfactorily at a daily volatile solids loading rate of 0:20 lb-ft$^3$ and a detention period of less than ten days. This showed that 1 ft$^3$ of digester volume is required for each pig produced within one year. A range of 7.8 to 10.3 ft$^3$ was the average gas yield per day per pound of volatile solids fed. Gas content was approximately 59 per cent methane, 40 per cent $CO_2$, with most of the remaining gas being free nitrogen. Based on research data and a average hog manure composition, about 3600 B.t.u.-day can be produced from the daily wastes of a pig. Digested manure characteristics were greatly improved through digestion. Also digestion reduced the organic matter of the raw manure and, thus, its potential pollutional strength by 60-70 per cent. Digester design and cost considerations are also discussed. (Penrod-East Central)

**2582-A4,A5,A6,A8,B1,E2,F3**

## THE LONG TERM MANAGEMENT OF ANIMAL MANURES,

Department of Agricultural Engineering, University of Newcastle upon Tyne
J. R. O'Callaghan, V. A. Dodd, and K. A. Pollock
Journal of Agricultural Engineering Research, Vol. 18, p. 1-12, 1973. 3 fig, 5 tab, 24 ref.

Descriptors: Nutrients, Odor, Water pollution, Crop response.
Identifiers: Land disposal, Application rates, United Kingdom.

Disposal problems have caused some farmers to resort to spreading manures on land at what could be considered as "dumping" rates of application. The purpose of this study is to examine the second order effects of indiscriminate dumping of animal waste and to provide guidelines for the rationalization of the management and disposal of manure by land spreading. Manure management is discussed in terms of a model, based on the mass balance of nutrients within a control area. In the steady state, application rate must be balanced by removal rate. This model takes into account imports of nutrients in the form of chemical fertilizers and feedstuffs. Animal manures can be utilized with chemical fertilizers for crop production with considerable benefit. Because excess nutrients are a pollution hazard and because land disposal often is accompanied by an odor problem, some form of treatment of manures prior to land disposal may be necessary. Consequently, more research needs to be done in these areas. (Penrod-East Central)

## 2583-B1, B4

### CLOSED CONFINEMENT BEEF BUILDING CALORIMETRY AND INFLUENCES OF THE MANURE STORAGE TANK,

P. G. Remmele
MS Thesis, South Dakota State University, Brookings, May, 1973, 83 p. 15 fig, 6 tab, 40 ref.

Descriptors: Confinement pens, Cattle, Storage tank, Latent heat, Ventilation.
Identifiers: Calorimetry, Heat production, Moisture production, Dry bulb temperature.

To successfully design a confinement livestock ventilation system, heat and moisture production data are necessary. The objective of this study was to determine the heat and moisture produced under actual conditions from a closed confinement beef building housing 47 Hereford steers, to determine the heat and moisture contributions to the environment from the manure storage tank located under the slotted floor, and to determine sensible and latent heat production from a closed confinement building. The study was done at the Farmer's Union Grain Terminal Association's modern and well designed beef research facility near Sioux Falls, South Dakota. The average daily total heat production of the building ranged from 1530 to 4070 Btu/hr/head and averaged 2870 Btu/hr/head. The sensible heat production of the building was generally negative above inlet dry bulb temperatures of 70 degrees F and building latent heat production increased for inlet dry bulb temperatures above 40 degrees F. Sensible heat production from the manure storage tank was inversely related to animal density. The removal of sensible heat from and the addition of latent heat to the animal area of the building was the overall effect of the manure storage tank. Significant prediction equations were determined for latent, sensible and total heat production of the building and building corrected for manure storage tank contributions and for sensible heat production of the manure storage tank. (Penrod-East Central)

## 2584-A5,A6,A8,B2,C2,D3,E2

### MINIMAL TREATMENT OF SWINE MANURE FOR IRRIGATION: EFFECT ON NITROGEN,

A. M. A. Shady
MS Thesis, Department of Agricultural Engineering, McGill University, Montreal, Quebec, Canada, May, 1973, 124 p. 19 fig, 20 tab, 37 ref.

Descriptors: Aerobic treatment, Nitrogen compounds, Irrigation, Effluent.
Identifiers: Swine, Groundwater pollution, Soil column, Leachate analysis, Nitrogen removal.

Continuous-flow aerobic treatment was applied to swine manure as a minimal treatment. The various levels of different nitrogen compounds were studied to determine the reduction of such compounds. Short-term aeration was found to reduce nitrogen content by as much as 40 per cent. Most of the nitrogen losses were as free ammonia stripped out of the reactor. Nitrate formation was very low due to limited oxygen supply. Changes in flow rate and/or detention time did not affect the amount of reduction of total Kjeldahl nitrogen or ammonium. The manure was applied in one application of one inch, two applications of one-half inch at 18 day intervals, and four applications of one-fourth inch at nine day intervals. Treatment applications of one inch gave the highest value of recovered nitrogen, which leads to the conclusion that the more waste added in one application the more immediate the effect; however, odor was most offensive in this application, even though previous aerobic treatment eliminated much of the odor. From this evidence it appears that applying the same amounts of nitrogen to the soil column in different applications will dilute the effect and spread it over a longer period. (Sanders-East Central)

## 2585-A2,A3,A4,A5,B2,E2,F4

### POLLUTION EFFECTS ON SURFACE AND GROUND WATERS,

Department of Civil Engineering, Hawaii, Honolulu
R. H. F. Young
Journal Water Pollution Control Federation, Vol. 46, No. 6, p. 1419-1429, June, 1974. 103 ref.

Descriptors: Water pollution sources, Nutrients, Heavy metals, Chemicals, Runoff.
Identifiers: Ground water pollution, Agricultural wastes, Radionuclides, Biological contamination, Soil contamination.

This report reviews literature concerning the pollution effects of various substances on surface and groundwater. Among the substances covered are: nutrients, agricultural wastes, chemicals, heavy metals and radionuclides, and biological contamination. Nutrient enrichment sources cited were sewage treatment effluents, industrial wastes, urban runoff, and agricultural runoff. Documented sources of agricultural pollution were: (1) percolates from surface irrigated dairy manure slurries, (2) storm runoff from cattle feedlots, (3) runoff from agricultural watersheds, and (4) seepage from wastewater irrigation. Chemical pollution sources cited were: oil field brine disposal; salt-water intrusion in coastal areas; irrigation-return flow; contaminants from outboard motor fuel; herbicides; use of deicing salts on highways; and the mobilization of the constituents in contaminated snow, such as heavy metals, oils, greases, phenols, and BOD from decaying organic matter. Heavy metal and radionuclide contamination sources that were discussed were discharges from gold recovery operations, use of nuclear reactors, and nuclear weapons tests. Sources of biological contamination that were cited included: (1) slime outbreaks due to industrial or domestic wastewater effluents, (2) coliforms due to discharges from boats and a faulty septic tank, and (3) viruses from septage filtrates. Reclamation by groundwater recharge, soil pollution, and modeling and analytical research methods were also reviewed. (Penrod-East Central)

## 2586-A7, A12, C3, D3, E2

### AIRBORNE HEALTH HAZARDS GENERATED WHILE TREATING AND LAND DISPOSING WASTE,

Department of Agricultural Engineering, University of Minnesota, St. Paul, Minnesota 55108
P. R. Goodrich, S. L. Diesch, and L. D. Jacobson
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 7-10.

Descriptors: Bacteria, Microorganisms, Air pollution, Health, Sampling, Waste treatment, Wind velocity.
Identifiers: Land disposal, Oxidation ditch, Wind direction, Spray disposal, Fecal coliforms, Fecal Streptococci.

Airborne micro organisms were monitored in several animal housing facilities. They were also monitored during spray disposal applications using irrigation equipment. All glass impingers were used for sampling. The all glass impinger (AGI) is designed to simulate the human respiratory system with respect to sampling rate (12.5 liters per minute) and particle size retention (1-10 microns). The AGI uses a vacuum to draw the air sample into a collecting fluid for scrubbing and then, through a critical orifice for volume measurement. Bacterial plate techniques were used to identify total bacteria, fecal coliforms and fecal Streptococci per liter of sampled air. The field sampling during waste disposal operation resulted in erratic information, due largely to the uncontrolled nature of the events. However, elevated levels of bioaercsols are definitely generated in the spray disposal process. These are carried beyond the wetted area and have the potential to travel many miles before settling. Care in selecting proper wind speed and direction conditions is needed. The results from Beef and Dairy barn sampling at three levels show that the oxidation ditch itself does not increase the hazard to man or animals in the housing environment or the nearby exterior environment. However, certain activities, such as cleaning, sweeping and facilities repair caused conditions hazardous to human respiratory system. Protective masks were indicated for persons engaged in these tasks. Higher counts were associated with the presence of animals in the facility and the relative activity of the animal. (Goodrich, et al-University of Minnesota)

## 2587-B2, C3

### SURVIVAL OF SALMONELLAE, TOTAL COLIFORMS AND FECAL COLIFORMS IN SWINE WASTE LAGOON EFFLUENTS,

Department of Microbiology, Clemson University, Clemson, South Carolina
D. J. Krieger, J. H. Bond, and C. L. Barth
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 11-14.

Descriptors: Salmonellae, Lagoons.
Identifiers: Fecal coliforms, Swine, Survival.

A study was undertaken to determine the survival characteristics of Salmonella cholerae-suis, Salmonella typhimurium, total coliforms and fecal coliforms in swine waste lagoon materials. Columns of swine waste lagoon material were loaded with various population densities of S. cholerae-suis and S. typhimurium. Enumeration of total and fecal coliforms employed MPN methods utilizing lactose broth and E C. medium, respectively. Enumeration of Salmonella was determined by MPN methods using Tetrathionate Broth, and confirmed by plating on Brilliant Green agar and agglutination with Salmonella O antiserum poly A-1. Initial population counts of 2.5 x $10^3$ organisms-ml of S. cholerae-suis and 7 x $10^4$ organisms-ml of S. typhimurium decreased to non-recoverable levels in 24 days. Initial natural populations of 20 organisms/ml of fecal coliforms showed complete die-off after 10 days, and natural populations of 3.3 x $10^3$ organisms-ml of total coliforms died off in 21 days. Survival times were also determined in columns which were loaded with high and low initial Salmonella populations. In all cases, the survival time of the organisms observed was determined by the initial numbers, whereas, the death rate of Salmonella was independent of the numbers in the original population. Efforts to recover bacteriophage from lagoon materials and loaded columns against coliforms and Salmonella were negative. Antagonisms were not responsible for die-off rates. Results indicated that depletion of an essential growth factor was probably the cause of death. (Krieger, et al-Clemson University)

## 2588-A9, A10, B2, F6

### MOSQUITO PRODUCTION AND CONTROL IN ANIMAL WASTE LAGOONS,

Department of Entomology, North Carolina State University, Raleigh, North Carolina 27607
R. C. Axtell, D. A. Rutz, M. R. Overcash, and F. J. Humenik.
Managing Livestock Wastes, Proceedings 3rd Inter-

national Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 15-18.

Descriptors: Mosquitoes, Lagoons, Insecticides, Simulation analysis.
Identifiers: Mosquito control, Swine.

Simulated waste lagoons (55 gal. drums) were operated for 6 months at different manure loading rates, which resulted in several organic pollution levels, and the numbers of mosquito larvae and pupae were determined weekly. The abundance of mosquitoes (mostly Culex quinquefasciatus) was correlated with the degree of pollution (measured as COD and TOC). With swine waste, mosquito production was optimal at about 320 cu. ft. of lagoon volume per 100 lb. hog with very little production at and below 80 cu. ft. per hog and at or above 1280 cu. ft. per hog. Similar mosquito production data for poultry waste loading rates are given. Also, mosquito production versus degree of pollution was determined weekly for 6 months at 5 on-farm operating swine lagoons. The effectiveness for mosquito control in simulated lagoons and in on-farm swine lagoons was determined for the following insecticides: malathion, chloropyrifos, Abate and Flit MLO. Also, the insect growth regulators TH6040 and Altosid were evaluated. No impaired lagoon performance was evident with the addition of these chemicals at the dosage rates used. The numbers of mosquito larvae were determined by a standard dipping method at frequent intervals before and after treatment. Mosquito control was obtained for periods of 7 days to 2 months depending upon the chemical and dosage rate. (Axtell, et al-North Carolina State University)

### 2589-A11, B1, C3

## PATHOGENIC MICROORGANISMS IN THE ENVIRONMENT,

Veterinary Services, Animal and Plant Health Inspection Service, Agricultural Research Center East, Beltsville, Maryland 20705.
G. B. Van Ness
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 19-21.

Descriptors: Pathogenic bacteria, Animal wastes, Livestock, Health, Water pollution.
Identifiers: Parasites.

Infectious diseases of livestock which are spread through manure and urine are the problems of herd management, unless the infectious agent also survives in the environment, and becomes a pollutant of other premises. Experience suggests spread to other premises depends on biological properties inherent in the pathogenic organisms. In pollution control, there is need to give attention to some organisms, while others may be of little concern. Pathogens which can grow and multiply in the environment are very important pollutants. Some pathogens persist in the environment. Some virus pathogens are able to survive longer in the environment than do others, and can be dangerous water pollutants. Current information is gathered regarding the differences, as a guide to further epidemiological and laboratory studies of polluting organisms. (Van Ness–Agricultural Research Center East, Beltsville, Maryland)

### 2590-B11,D1,D2,D3,E2,E3, F1,F4

## ENGINEERING AND ECONOMIC OVERVIEW OF ALTERNATIVE LIVESTOCK WASTE UTILIZATION TECHNIQUES,

Departments of Agricultural Engineering and Economics, Colorado State University, Fort Collins, Colorado 80523.
J. M. Harper and D. W. Seckler
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 22-25.

Descriptors: Economics, Recycling, Energy, Methane, Fertilizer.
Identifiers: Manure, Wastelage, Refeeding, Pyrolysis, Land spreading.

Beef manure may be utilized as follows: (1) Refeeding—dried manure, wastelage, fractionated manure, and fermented manure; (2) Energy—Anaerobic fermentation-methane, Anaerobic fermentation-some methane with refeeding of biomass, pyrolysis; (3) Fertilizers—land spreading (dry), land spreading (irrigation). To compare these alternatives accurately, an engineering evaluation of the capital requirements and operating costs associated with each alternative is developed using a 10,000 head confinement feedlot as the basis of comparison. Common to all these systems is a manure collection system. Each then requires various additional capital costs to allow utilization in the manners outlined. An economic analysis was run using the capital and operating cost estimates to determine the production costs of the products of each of the utilization methods. These production costs were then compared to current and projected prices for feed, energy and fertilizer to determine the economic viability of the alternatives. It appears that processes producing refeedable products show considerable economic potential. Unless anaerobic fermentation processes can be sped up, thereby reducing capital requirements and the value of methane increases substantially, methane production appears to be a poor alternative to refeeding manure as a method of utilization. Utilization of manure as fertilizer depends extensively on circumstances such as distance and availability of disposal sites. Costs increase rapidly as distances increase. (Harper & Seckler-Colorado State University; Merryman, ed.)

### 2591-B1, E3, F1

## AN ECONOMIC ANALYSIS OF METHANE GENERATION FEASIBILITY ON COMMERCIAL EGG FARMS,

Department of Agricultural and Food Economics, University of Massachusetts, Amherst
T. C. Slane, R. L. Christensen, C. E. Willis, and R. G. Light
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 26-29.

Descriptors: Methane, Feasibility studies, Poultry, Economics, Costs, Energy.

The study focused on determination of net costs associated with adoption of a methane generation system by commercial egg production units of 20,000, 40,000 and 80,000 birds in a cage housing system. Only costs and returns attributable to the methane generating system were considered. A model methane generation system was developed that satisfied the technical requirements for the anaerobic process. The system was specified in terms of size and operating characteristics as determined by the waste production of each flock size. Daily loading of the digester was assumed. The methane generated was used to fuel an engine-generator(s). The engine-generator was assumed to run continuously and provide supplementary electrical power. Specifically, the electricity generated would be sufficient to fulfill the requirements for lighting and ventilating fans in the production operation as well as those associated with operation of the digester itself. Thus, the primary or commercial power sources could be considered as "stand by" for those electrical requirements. The fixed and variable costs of the system were estimated for the three benchmaker operations by identifying the fixed and variable factors associated with the system, estimating input requirements, and budgeting costs for each unit. The results indicate that the system studied was not economically feasible at present. This conclusion is directly related to the assumed cost of commercial power. For the smallest flock size a commercial electrical cost of nearly 10 cents per kilowatt-hour would be a "breakeven" while for the largest size the "breakeven" is about 6 cents per kilowatt-hour. It is conceivable that commercial electricity prices might reach such levels within the next decade. (Slane, et al-University of Massachusetts; Merryman, ed.)

### 2592-A1, E2, F1

## ECONOMICS OF SUBSTITUTION AND THE DEMAND FOR BEEF FEEDLOT WASTES: ONE ALTERNATIVE FOR SOLVING ENVIRONMENTAL QUALITY PROBLEMS,

Department of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma 74074
D. D. Badger
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 30-32.

Descriptors: Economics, Fertilizers, Feedlots, Cattle.
Identifiers: Manure, Environmental quality.

Three years ago, when manufactured fertilizer was abundant and prices were relatively low, it was increasingly difficult to convince farmers to buy and use manure on their cropland. Since 1972, crop producers have been encouraged to plant all acres that previously were in set-aside programs. Demand for fertilizers to bring these 40 million acres of land back into production, as well as price controls imposed on domestic fertilizer prices in 1972 and early 1973, caused fertilizer shortages. Lifting of the price controls in 1973 caused sky-rocketing prices for fertilizers. Consequently, alternative nutrient sources for crop lands have been in demand. Thus, cropland farmers have been willing to pay for beef feedlot wastes, as well as for higher transportation costs. A survey of 60 beef cattle feedlots in the Oklahoma and Texas panhandle is underway to determine the supply and demand situation for beef feedlot wastes and resulting environmental quality implications. (Badger-Oklahoma State University; Merryman, ed.)

### 2593-A1, B1, F1, F4, F6

## ECONOMIC RESEARCH PERTAINING TO PROBLEMS OF LIVESTOCK WASTE MANAGEMENT AND POLLUTION CONTROL,

Department of Agricultural Economics, Michigan State University, East Lansing
L. J. Connor and J. B. Johnson
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 33-36.

Descriptors: Livestock.
Identifiers: Economic research, Waste management, Pollution control, Literature review, State of the art.

This paper presents a literature review on the state of the art in the economic analysis of livestock waste management and pollution control problems, a discussion of major economic research findings, and suggestions for future research. Past economic research pertaining to problems of livestock waste management and pollution control are summarized by the following categories: (1) least-cost livestock waste management systems; (2) industry structure studies pertaining to the distribution of firms by size, housing type, and waste management system; (3) nonmarket control measures for effectuating pollution control; (4) economic impact studies (static and dynamic) of nonmarket control measures; (5) economic analyses of recycling animal waste; (6) energy costs associated with alternative waste management systems; and (7) miscellaneous studies. Research studies on these problems are appraised relative to the major conclusions which can be drawn, inconsistencies in major conclusions and methodologies employed in the research studies reviewed, and apparent research voids. The impacts of alternative pollution control measures are analyzed with respect to the likely effects upon individual livestock producers, the size and technology distribution of livestock production units within each industry, consumer prices, and implications for pollution control agencies. Conclusions relative to least-cost waste management systems (with and without pollution control measures assumed) are drawn wherever data are available. Research voids and areas where various research studies show conflicting results are noted. (Connor & Johnson-East Lansing; Merryman, ed.)

### 2594-B1, F1, F2,

## ECONOMICS OF ALTERNATIVE BEEF WASTE MANAGEMENT SYSTEMS,

Department of Agricultural Economics, Institute of Agriculture and Natural Resources, University of Nebraska, Lincoln
M. Baker
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 37-40.

Descriptors: Economics, Cattle, Feedlots, Confinement pens.
Identifiers: Waste management.

Livestock producers who are installing waste management systems want to know the least cost system that will meet EPA and state pollution regulations. Three waste management systems for unpaved feedlots and three systems for confined feeding facilities were studied in Nebraska. Initial investment and operating costs of disposal systems were included in the study. This provides a total picture of cost of handling waste associated with beef cattle feeding. Data were obtained from owners and operators of operational systems on initial investment, amount of materials required and disposal systems to be used. Costs for disposal equipment were obtained from manufacturers, dealers and suppliers of this equipment. Recognition of microbial decomposition on the feedlots was included in the study. Initial investment in beef feedlot waste management systems is substantial and provides no additional revenues to the feeder. Annual operating costs are minimal; however, even this represents an increased cost of feeding cattle. With a large fixed investment, there are considerable reductions in cost per head capacity as the size of feedlot increases, but most of these reductions are realized by feedlots with capacities of approximately 500 head. Thus, the annual cost per head for extremely large management systems for confined feeding facilities are considerably more expensive to construct than are those for unpaved feedlots. This largely reflects the additional materials required for such systems. (Baker-University of Nebraska; Merryman, ed.)

### 2595-A2, A4, E2, F1, F2

## ECONOMIC IMPACTS OF ALTERNATIVE WATER POLLUTION CONTROL RULES ON BEEF FEEDLOTS OF LESS THAN 1000 HEAD CAPACITY,

Department of Agricultural Economics, Ohio State University
D. L. Forster, L. J. Connor, and J. B. Johnson
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 41-44.

Descriptors: Legislation, Water pollution control, Feedlots, Cattle, Economic impact, Agricultural runoff.
Identifiers: Environmental Protection Agency.

Estimates are made of the economic impacts of four alternative water pollution rules on the behavior of beef feedlots over the 1975-1985 period. The four alternative water pollution control rules applied to beef feedlots of all capacity levels were: (1) current EPA guidelines requiring control of feedlot runoff from the local 10-year, 24-hour rainfall and process generated waste waters by 1977 and runoff from the local 25-year, 24-hour rainfall and process generated waste waters by 1983; (2) the construction of control facilities for control of the local 25-year, 24-hour storm and process generated waste waters by 1983; (3) the control of all runoff from rainfall occurring in any six-month interval by 1977; and (4) the control of all runoff from rainfall occurring in a six-month interval and no winter spreading of feedlot solid wastes. A simulation model was used to represent the production behavior of beef feedlots typical of the Lake States and Corn Belt over the 1975-1985 period. Imposition of rule 1 on feedlots of less than 1,000 head would result in an average feedlot firm equity loss of $3,720 over the 1975-1985 period. Rule 2 would result in average equity loss of $3,911 over the 1975-1985 period. Rule 3 would result in average equity loss of $4,800 per feedlot. Rule 4 would result in an average equity loss of nearly $6,000 per feedlot over the 1975-85 period. The decline in marketings would range from one-half to one per cent under the four rules over the 1975-1985 period, resulting in only nominal price increases for fed beef. Economic effects at the feedlot level would not be uniform, placing the greatest burden on the smaller feedlots. (Forster, et. al.-Ohio State University; Merryman, ed.)

### 2596-B1, F1, F2

## EFFECTS ON ENVIRONMENTAL LEGISLATION ON CATTLE FEEDLOT LOCATION,

Industrial and Systems Engineering, Ohio State University, Columbus
D. L. Byrkett, E. P. Taiganides, and R. A. Miller
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 45-48.

Descriptors: Model studies, Locating, Costs, Economics.
Identifers: Federal Water Pollution Control Act Amendments of 1972, Cattle feeding.

The paper discusses the development of a cost minimization linear programming model which was used to study the effect of the 1972 Federal Water Pollution Control Act Amendments on the location of cattle feeding in the continental United States. Factors affecting feedlot location which were included in the model are feeder, grain and roughage availability; slaughter capacity, demand requirements, nonfeed costs, and transportation costs. The United States was divided into sixteen cattle feeding regions; all data were developed for the year 1972. This model has two unique features. One is the separate definition of regions for cattle feeding, feeders, grain, roughage, slaughter, and demand. The other is that the model considers the competition between cattle feeding and other uses for available land. This competition is modelled by increasing nonfeed costs as production in a given region increases. In regions where competition for available land is great, nonfeed costs increase more rapidly; nonfeed costs increase less rapidly where competition is small. The model was then used to determine the minimum cost equilibrium location of cattle feeding. These results indicated continued growth in the southern plains and continued declines in the corn belt, eastern United States, and California. To model the effect of the Federal Water Pollution Control Act Amendments of 1972, the nonfeed costs were adjusted to describe the impact of this legislation on each cattle feeding region. Equilibrium locations were then calculated using the adjusted nonfeed costs and were compared with the equilibrium locations calculated without the legislation in effect. (Byrkett, et. al.-Ohio State University)

### 2597-A2, A4, B2, F1, F2

## ECONOMIC IMPACTS OF IMPLEMENTING EPA WATER POLLUTION CONTROL RULES ON THE UNITED STATES BEEF FEEDING INDUSTRY,

Agricultural Economists, Economic Research Service, USDA, East Lansing, Michigan
J. B. Johnson and G. A. Davis
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 49-52.

Descriptors: Economic impact, Feedlots, Agricultural runoff, Effluent.
Identifiers: Federal Water Pollution Control Act Amendments of 1972, Environmental Protection Agency, Point source discharges.

The Federal Water Pollution Control Act Amendments of 1972 provide a mandate for the EPA to achieve improvements in the quality of navigable waters. EPA announced effluent limitations for beef feedlots in February, 1974. By July 1, 1977, feedlots with point source discharges will be required to have in use the "best practicable control technology currently available." The guidelines require no discharge of waste waters from feedlots except those in excess of control systems designed to accommodate runoff from local 10-year, 24-hour rainfalls and process generated waste waters. These guidelines are to be administered through National Pollutant Discharge Elimination System permits for beef feedlots of 1,000 head or more capacity. (However, beef feedlots of smaller capacity may be expected to comply through NPDES or State permit programs.) The objectives of this paper are: (1) to estimate the number of beef feedlots which could be subject to effluent guidelines and (2) to estimate the economic impacts on the beef feeding industry. It is estimated that an additional $133 million capital outlay would be necessary to allow the 49,000 beef feedlots of all capacity levels with problems to be in compliance with EPA rules by 1977. This level of industry investment would be needed to provide feedlots with control systems consisting of diversion terraces, a settling basin, a retention pond, and pump irrigation equipment for distributing runoff to farmland. As things now stand, 95 per cent of the investment would be imposed on feedlots with less than 1,000 head capacity. Investments could range from $8 to over $100 per head for feedlots of less than 1,000 head capacity adopting runoff control systems. For larger feedlots, per head investment would average $1.40 to $3.20 per head. (Johnson and Davis-USDA; Merryman, ed.)

### 2598-A3, A8, C2, E2, F1, F6

## ECONOMIC AND ENVIRONMENTAL ASPECTS OF DAILY AND ANNUAL DAIRY MANURE SPREADING SYSTEMS IN A SMALL WATERSHED,

Pennsylvania State University Extension Service, Reading, Pennsylvania
W. H. Schaffer, G. L. Casler, and J. J. Jacobs
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 53-56.

Descriptors: Economics, Dairy industry, Watersheds, New York, Model studies, Nitrogen, Phosphorus.
Identifiers: Land spreading, Soil loss.

This paper reports the simulated nitrogen, phosphorus and soil loss from a 7,000 acre watershed where daily manure spreading is practiced. It also reports the simulated results when the system is changed to 12 months storage combined with direct incorporation of manure within 24 hours. The simulated nitrogen, phosphorus and soil losses from the two systems are incorporated into an analysis to determine the economic and environmental impact of controlling nutrients losses from the watershed under various policies. The physical model was constructed from published laboratory and field data and had sub-components for soil moisture, soil temperature, soil movement, nitrogen and phosphorus. The basic economic model was structured to be representative of the kinds, amounts and intensities of agriculture found by survey in a small central New York watershed. The modeling suggests that farm costs of reducing nutrient losses to water are substantial. In addition to the loss of nutrients to water, there are other environmental factors, such as odor, flies and appearance, to consider when evaluating dairy manure handling systems. A summary of the cost and environmental impact, which is a combination of 7 environmental characteristics, of alternative dairy manure handling systems is included. Above results indicate that manure handling systems need to be carefully evaluated for their economic and environmental impact. (Schaffer-Pennsylvania State University Extension Service; Merryman, ed.)

2599-A4,B1,B4,E2,F1,F2

### IMPLICATIONS OF SELECTED NON-POINT SOURCE POLLUTION REGULATIONS FOR U.S. DAIRY FARMS,

Agricultural Economist, USDA, University of Minnesota
B. M. Buxton and S. J. Ziegler
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 57-60.

Descriptors: Legal aspects, Dairy industry, Costs, Waste storage.
Identifiers: Non-point Source Pollution Control Regulations, Land disposal.

Federal regulations governing the land disposal of animal wastes may be forthcoming. Some states have enacted regulations or guidelines which restrict manure disposal. This study focuses on possible non-point source pollution control regulations; the number of U.S. dairy farmers affected by alternative disposal restrictions; and, where applicable, the costs of compliance with these regulations. Alternative non-point regulations are selected from existing or proposed state guidelines and these regulations are imposed on U.S. Dairy farms. The following criteria are considered: restricting dairy cows, animal units, manure tonnage, and nitrogen applied per acre, and manure disposal on rolling or steeply sloping ground. The number and proportion of producers exceeding alternative restrictions are estimated based on a recent survey of U.S. dairy producers. The number of producers in the northern United States who spread manure during winter months are estimated and the aggregate cost of manure storage calculated. In addition, the location of individual U.S. dairy farms with respect to the nearest farm residence, nearest community, and public recreational area is estimated. (Buxton and Ziegler-University of Minnesota)

2600-A4,B1,B2,F1,F2,F4

### FEEDLOT EFFLUENT LIMITATIONS BASED UPON EXEMPLARY OPERATIONS,

Chief, Impact Analysis Section, Technical Analysis and Information Branch, Effluent Guidelines Division, Environmental Protection Agency, 401 M Street, S. W., Washington, D.C.
J. D. Denit
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 61-63.

Descriptors: Legislation, Feedlots, Water pollution, Effluent, Poultry, Costs, Geography, Climates.
Identifiers: Pollution control, Federal Water Pollution Control Act.

As one of the specifically enumerated industrial point sources of pollution, feedlots are required to comply with certain pollution control standards as stipulated in Sections 301, 304, and 306 of the Federal Water Pollution Control Act, as amended, 1972, (The Act). In response to requirements in the Sections, a regulation which sets forth the specific effluent limitations for feedlots was promulgated on February 14, 1974. The substance of the limitations thus established was "no discharge of pollutants to navigable water," Subject to an exception for discharges due to unusual rainfall conditions. The limitations impact existing feedlots with effluent limitations for 1977 and 1983, and new feedlot sources (as of September 7, 1973) with standards of performance and pretreatment standards. A general survey of exemplary feedlot operations is given with emphasis on the following: (1) A brief description to identify the salient features of the exemplary control concepts for a variety of livestock and poultry operations (with slides of actual facilities). (2) An illustration of applicability of the exemplary concepts to existing facilities with pollution problems, including geographic and climatic variability. (3) A review of the courses of action available to feedlot operations and responsible governmental and institutional officials. (4) An assessment of the general costs of achieving the effluent limitations for farms using current data estimates. The exemplary operations to be discussed include facilities involving open lot production of beef cattle, swine, and sheep; and, housed lot production for poultry, dairy cattle, swine, and beef cattle. Tables of associated costs for various sizes and types of facilities are presented. (Denit-EPA; Merryman, ed.)

2601-A6, A7, B1, F2

### LEGAL ASPECTS OF ODOR POLLUTION CONTROL,

Attorney, Director of Legal Division, Texas Air Control Board, Austin, Texas
P. M. Giblin
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 64-65.

Descriptors: Air pollution, Legislation, Feedlots, Livestock.
Identifiers: Odor abatement, Public hearings, Litigation.

Most legally recognized definitions of air pollution are written in nuisance terms. That is, they include some reference to "adverse effects on human health or welfare" or "interference with the normal use and enjoyment of animal life, vegetation or property." The Texas Air Control Board has been active in various enforcement actions involving odors from livestock feedlots. One successful lawsuit resulted in court-ordered relocation of the feedlot. Other suits have produced court-ordered nuisance abatement procedures. The proposed paper deals with the issues involved in determining a feedlot's compliance with air quality requirements. Also discussed are mechanisms for legal resolution of problems associated with feedlots. Public hearings are often held by air quality control agencies to review nuisance problems and examine possible corrective measures. If litigation is not warranted, an administrative enforcement order may be issued. In the drafting of such an order, technical and legal personnel work together to outline odor abatement steps and timetables for compliance. (Giblin-Texas Air Control Board)

2602-A2,A5,B1,B4,E2,F2

### PARTNERSHIP IN POLLUTION CONTROL,

Illinois Pollution Control Board, Chicago, Illinois
R. T. Odell
Managing Livestock Wastes, Proceedings 3rd International Symposium on lifestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 66-67.

Descriptors: Water pollution, Legislation, Feedlots, Illinois.
Identifiers: Pollution control, Waste management, Permits.

The 1970 Illinois Environmental Protection Act established the following 3 organizations for environmental protection: (1) The Pollution Control Board, which establishes regulations to protect the environment and sits as a quasi-judicial body that rules on cases of alleged violation of regulations; (2) The Illinois Environmental Protection Agency which monitors the environment and which, along with citizens, brings alleged polluters before the Pollution Control Board; and (3) The Illinois Institute for Environmental Quality, which collates environmental information. The current Illinois Livestock Waste Regulations are intended to meet requirements of the National Pollution Discharge Elimination System, established by the Federal Water Pollution Control Act Amendments of 1972. The most important provisions provide for the handling, storage, and field application of livestock wastes; for existing and new livestock facilities to be constructed to prevent excessive outside surface waters from flowing through the feedlot and to direct feedlot runoff to an appropriate disposal or storage area; and the location of new livestock facilities with regard to surface waters, flood plains, unsatisfactory soil conditions, and population centers. Procedures were established for inspecting feedlots under investigation. Permits are required of livestock operations with a total of more than 1000 animal units, and other livestock operations with 999 to 100 animal units that are causing significant pollution to obtain a permit. (Odell-Illinois Pollution Control Board; Merryman, ed.)

2603-A4, B1, F2

### THE NPDES DISCHARGE PERMIT PROGRAM FOR AGRICULTURAL POINT SOURCES,

Department of Agricultural Engineering, Purdue University, West Lafayette, Indiana
J. C. Nye
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 68-70.

Descriptors: Regulation, Feedlots, Permits, Effluent, Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin.
Identifiers: Federal Water Pollution Control Act, Point sources.

Congress passed the Federal Water Pollution Control Act Amendments on October 18, 1972. This Act has had far reaching impact on the agricultural community. Section 306(b) (1) (A) specifically identified "feedlots" as one of the point sources for which a "Federal Standard of Performance for New Sources" has had to be prepared. Concentrated animal feeding operations were identified as "point sources" of pollution in the Act, and therefore were required to apply for a National Pollutant Discharge Elimination System (NPDES) permit. This paper presents an explanation of how the agricultural portion of the NPDES program was implemented in Region V of the U.S. Environmental Protection Agency, for the states of Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. The methods employed to obtain applications from the large feedlots are described. The interpretation of the "Feedlot Point Source Category, Effluent

Guidelines and Standards" as published in the February 24, 1974, Federal Register and the subsequent development of an agricultural permit form is discussed. The paper also discusses the interfacing of the Federal program with existing and proposed State programs for controlling pollution from feedlots. A brief review of the total NPDES program is presented. (Nye-Purdue University)

2604-A4,A6,B2,D2,D3,E2, E3,F1

### TECHNIQUES THAT ARE SOLVING POLLUTION PROBLEMS FOR POULTRYMEN

New York State College of Agriculture and Life Sciences, Cornell University, Ithaca, New York
C. E. Ostrander
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 71-73.

Descriptors: Poultry, Waste treatment, Waste disposal, Odor, Water pollution, Aeration, Dehydration, Economics.
Identifiers: Soil injection, Oxidation ditch, Refeeding.

Poultrymen, who have struggled in the past with the pollution problem, are now accepting research information and putting it into practice. Some techniques are not economically feasible at the present time but many are. Some of the more applicable and successful are: (1) The "High Rise" poultry house, when constructed and managed properly, has aided in preventing pollution and provides maximum flexibility. Site selection and preparation as well as proper drainage and management are key factors for success. (2) Soil injection has proven very successful where odors from spreading anaerobic material is the primary problem. This does not prevent "house odors" or odor from storage. Closed storages are required because soil injection may have to be a seasonal operation in many instances. (3) Dehydration can prevent odors if fresh material is used with proper equipment and adequate afterburners. Adequate markets are necessary if this is to be economically feasible. If the dehydrated product is approved for use as an animal protein supplement this will aid large producers with little land, tremendously. (4) The oxidation ditch, which has a higher investment cost, can aid producers located in populated areas. This can be operated practically odor free and the effluent and-or sludge can be spread almost anyplace, at any time, without offending anyone. Effluent cannot be admitted to waterways without further treatment. (5) Surface aeration, much like the oxidation ditch, reduces odors. Being outside it does not function as efficiently during cold weather, in northern climates. There may be some odors during the spring when microbial activity increases. It is subject to "slug loading" which may produce some odor and foaming. Sufficient volume and aeration are essential and it is probably more applicable in warm climate areas. (Ostrander-Cornell Univ.)

2605-A7, B3, D1, D2

### MODIFICATIONS OF THE MICHIGAN STATE POULTRY IN-HOUSE DRYING SYSTEM,

Poultry Science Department, Michigan State University
C. C. Sheppard, C. J. Flegal, H. C. Zindel, T. S. Chang, J. B. Gerrish, M. L. Esmay, and F. Walton.
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 74-77.

Descriptors: Design, Michigan, Dehydration, Poultry, Measurement.
Identifiers: In-house-drying system.

Recent reports at the Cornell Waste Conference (1974) and XIV World's Poultry Congress (1974) have given progress reports of the Michigan State In-House-Drying System. Recent modifications have been made: (1) to improve the in-house drying capability, (2) to decrease or even eliminate the pollution emissions from the house, (3) to eliminate the need for the afterburner on the manure dehydrator. Recent modifications include change from a V type trough waterer (that dripped or overflowed regularly) to a four inch continuous (formed in place) aluminum eave trough. A second change has been the modification of a stirring device to stir the manure being in-house-dried. A third recent change has been the addition of a recirculating in-house air system. The fourth change has been the addition of hydro-filter chamber (tower) to lessen or eliminate the emissions coming from the 5,000 bird house and the manure dryer. Measurements are being made on: (1) Moisture content of in-house dried manure with the new stirring device. (2) Moisture content of in-house dried manure with the addition of the recirculating air. (3) The emissions from the house before and after the hydro-filter. (Sheppard, et. al.-Michigan State University)

2606-B3, D1, D2, E3. F1

### DESIGN OF A POULTRY MANURE DRYING SYSTEM FOR A 155,000 LAYERS EGG FACTORY,

Engineering Consultant, P.O. Box 195, Prague, Czechoslovakia.
K. Koskuba
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 78-82.

Descriptors: Design, Poultry, Drying, Cattle, Cost analysis.
Identifiers: Czechoslovakia, Refeeding.

This paper presents technical information and operating experience on a poultry manure drying system based on an industrial flash dryer-pulverizer (ATRITOR, produced by Herbert Assn., Coventry, England) for the confined housing with the capacity of 155,000 layers at one of the most advanced Czechoslovak poultry farm. The farm yearly output makes 31 mills of eggs, 240 metric tons of meat, and 1300 metric tons of high quality dehydrated poultry manure used for feeding cattle. The manure processing system contains automatic manure scraping and its instant conveying into a trailer with each house of capacity of 10,500 layers. The fresh manure is transported to the drying plant, moisture is removed, and the dried material is conveyed to a cyclone and bagged with a capacity of 300-400 kgs per hour depending on the fresh manure moisture content. The system components and system parameters are described. The reason for the selection of the type of dryer and description of ATRITOR dryer-pulverizer. Scrubbing of the flue gas. Cost analysis and evaluation are made of the plant performance along with discussion of existing problems. (Koskuba-Czechoslovakia)

2607-A6,A7,A10,B3,B5,C2, D1

### IN-HOUSE MANURE DRYING–THE SLAT SYSTEM,

Agricultural Development and Advisory Service, Shardlow Hall, Shardlow, Derby DE7 2GN, England
H. A. Elson and A. W. M. King
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 83-84.

Descriptors: Design, Poultry, Drying, Odor, Ventilation.
Identifiers: United Kingdom, Slat system, Fully-stepped cages, Flat-deck cages.

In-house manure drying systems are of benefit in deep-pit poultry buildings for several reasons: (a) They reduce manure moisture content, thus reducing its weight, rendering it easier to handle, and enhancing its value. (b) Problems associated with wet pits (ammonia, odors, flies) are avoided. (c) A more amenable environment is provided for staff and stock. (d) Odor emission from buildings is reduced. The slat system, developed in the United Kingdom, is an efficient and economical method of achieving these objectives—drying manure to 10-15 per cent moisture. The system has been used in deep-pit houses having downward flow ventilation systems, with fully-stepped or flat-deck cages. It may also be possible to develop a similar system for semi-stepped cage configurations. The technique is to collect manure falling from laying stock directly on slats which retain it in columns subjected to continuous drying. The system operates efficiently because: (1) Fresh manure adheres continuously, producing tall columns with high surface area. (2) The warm ventilation air passes over these columns before being exhausted below the slats. (3) Heat is provided by stock as they metabolise the energy of the food, and air movement by the existing ventilation. It was found that slats 4-6 inches wide gave best results; that rapid initial drying results in excellent nitrogen retention; and that, at a low ventilation rate (0.5 c.f.m. per bird) atmospheric ammonia was 13 p.p.m. in a slatted bay and 26 p.p.m. without slats. (Elson and King-Agricultural Development and Advisory Service; Merryman, ed.)

2608-A2, A8, B2, E2, F2

### CONTROL, COLLECTION, AND DISPOSAL OF FEEDLOT RUNOFF,

USDA, University of Nebraska, Lincoln, Nebraska
N. P. Swanson, L. N. Mielke, and C. L. Linderman
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 85-87.

Descriptors: Regulation, Engineering, Design, Feedlots, Water pollution, Nebraska.
Identifiers: Runoff control.

As a result of pollution control regulations, many feedlots have instigated pollution control measures; but often they have done so utilizing fallacious concepts and without sufficient knowledge and background of engineering principles. The application of proven soil and water engineering principles has provided adaptation of practices and facilities to abate the water pollution hazard. Collection of hydrologic data from feedlots and interpretation of meteorological records has provided values for the parameters and variables involved in designs. Applications include diversions to eliminate surface runoff into feedlots, terraces to control overland flow within feedlots, basins and solids traps for the collection of runoff transported solids, riser inlets and underground conduit for conveyance of collected runoff, sumps and pumps to provide lift for feedlot drainage where gravity flow is not possible, holding ponds for storage of runoff effluent, pumping and distribution equipment for applying the effluent to the land, and management of effluent on crops, and soils for nutrient utilization and control of pollution hazards. Full consideration of applicable practices and techniques and avoidance of stereotyped concepts is necessary in engineering for pollution abatement of outdoor feedlots. Even then, failures can occur. The design of runoff controls on a feedlot must also provide for animal comfort, minimize management requirements, and keep investment and maintenance costs commensurate to potential income and benefits to the environment. (Swanson-USDA: Merryman, ed.)

2609-A2, B2, B4, E2

### MANAGEMENT OF RUNOFF WATER IN RELATION TO FEEDLOT OPERATIONS,

Hydraulic Engineer, USDA-Soil Conservation Service, Temple, Texas 76501

H. N. McGill and G. C. Vittetoe
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 88-92.

Descriptors: Agricultural runoff, Feedlots, Economics, Lagoons, Irrigation.
Identifiers: Land disposal.

Presently, the most practical and economical system for cattle feedlot runoff control is one where (1) as much outside drainage as possible is diverted from the feedlot, and (2) the runoff water from the feedlot proper is intercepted and impounded in holding ponds, and later disposed of on agricultural crops. Disposal lagoons designed to treat solid and liquid wastes from feedlots have very limited application in cattle feedlot pollution abatement systems due to the size of the surface areas required for such lagoons. Therefore, systems of retention and irrigation which result in a "no-effluent" condition are the type best suited for cattle feedlots. In planning and designing the retention-and-irrigation-type abatement systems, the size of irrigated area in relation to the area of the feedlot must be considered for the varied conditions that can be encountered. This paper illustrates the development of cattle feedlot runoff management tools that can be used for a wide range of climatic and management conditions. These tools relate annual precipitation to feedlot storage requirements and irrigation area-feedlot area ratios needed to prevent spills for specific frequencies. These can be used to (1) determine the size of area to prepare for disposal of runoff from a specific feedlot, (2) plan for the use of feedlot runoff as a source of irrigation water, (3) predict the climatic or moisture conditions at times when holding ponds must be dewatered and (4) evaluate the influence which storage capacity of holding ponds has on frequency of spillage from the ponds and the timing of irrigations with the runoff water. (McGill and Vittetoe-USDA; Merryman, ed.)

### 2610-A2,B2,B3,B4,D1,E2

### AN ILLINOIS FEEDLOT RUNOFF CONTROL PROJECT,

Dairy Farm Owner, Jo Daviess County, Illinois
R. Lawfer
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 93-95

Descriptors: Illinois, Feedlots, Design, Sprinkler irrigation.
Identifiers: Runoff control, Settling basin, Land spreading.

A report is given on the experiences and observations of a farm owner-operator concerning the operation of a livestock waste management system installed on his farm in northwestern Illinois in the summer of 1973. This project was designed to prevent possible point source pollution from this feedlot, and to provide needed research on water quality, engineering design standards, and on disposition of livestock wastes. A continuing study by the University of Illinois involves collection and analysis of samples of water, plants and soil, to monitor the levels of chemical substances from manure in nearby wells and streams, and in soil. An up-to-date summary of results from this study is in this paper. This "zero runoff" system includes a diversion, earthen dikes, a concrete basin for settling out waste solids, and a holding pond for temporary storage of liquids. Solids from the feedlot and settling basin are moved with solid manure handling equipment and spread on pasture or cropland. All contaminated runoff and liquid wastes from the feedlot are stored until they can be applied to the soil. A small solid set and movable irrigation system is used to empty the holding pond. Liquid from the pond can be applied through sprinklers to seven (7) acres of cropland. Alternatively, a drain pipe allows pond liquid to be applied by gravity to a small area of permanent pasture by use of perforated pipe. The paper includes the author's evaluation of the system's performance during eighteen (18) months of operation. Management skills and minor changes in design standards are recommended in his conclusions. (Lawfer-Illinois; Merryman, ed.)

### 2611-B2, B4, D1, E2

### FEEDLOT WASTE RECYCLING WITH A FLUSH CLEANING SYSTEM,

Department of Agricultural Engineering, Clemson University, Clemson, South Carolina
C. L. Barth and R. W. Goethe
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 96-97.

Descriptors: Feedlots, Waste storage, Waste disposal, South Carolina, Design, Lagoons, Sprinkler irrigation, Southeast. U. S.
Identifiers: Flush waste handling system, Land disposal.

Feedlots in the Southeast United States, due to high rainfall, require large amounts of labor and equipment to handle animal waste in solid form. Adverse weather conditions and cropping systems prevent continuous operation of solid waste handling equipment on cropland and interrupt work schedules. To combat the waste handling problem, odors and to reclaim plant nutrients by recycling, Walworth Plantation near Eutawville, South Carolina, constructed in 1973 a 5,000-head capacity feedlot with a (water) flush waste handling system. This type system is not new to the animal industry but is unique in the beef feedlot industry. The feeding layout is constructed in a "V" shape with 20 pens on each slope. The pens have a uniform slope of 2 and one half per cent to a central collection canal. Each pen is 30 feet wide, 120 feet long with a capacity of 125 head of cattle. The pens are constructed back to back with an unpaved working alley between the rows of pens. The central collection ditch diverts all runoff waste and water into a large concrete holding tank equipped with an agitator. The waste is agitated and pumped with a manure pump to a sprinkler irrigation system. The waste is applied on forage crops and pastures. As a back-up system in case of mechanical failure or prolonged adverse weather conditions, a 2 and one half acre excavated lagoon and a 15-acre natural lagoon can be used to prevent discharge to streams and to comply with effluent guidelines for the feedlot industry. Walworth Plantation has approximately 1,900 acres in cultivated crops and pasture that can be used for waste application. Presently, the waste is being utilized on 300 acres and 600 acres and can be covered with equipment on hand. (Barth-Clemson University)

### 2612-B2, B5, D3, E3

### OPERATION OF BEEF MANURE FLUSHING SYSTEM IN A COLD CLIMATE,

Beef producer in Ada, Minnesota; Assistant Professor of Agricultural Engineering, University of Minnesota, St. Paul, Minnesota.
H. A. Natwick and P. R. Goodrich
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 98-100.

Descriptors: Confinement pens, Minnesota, Design, Lagoons, Waste treatment, Aeration, Recycling.
Identifiers: Flushing gutter, Waste water reuse.

An open beef housing unit for 100 animals was constructed to use a flushing gutter waste management system. Operation through two winters in Northern Minnesota show that the system will work satisfactorily in cold climate conditions. The owner had previously observed from his conventional solid floor cold confinement units that the manure remained pliable on the floors in below zero weather. Extreme conditions of -35 degrees F caused the manure to solidify, then again, became pliable when the temperature moderated to zero or above. The new complete system consists of a south facing open cold confinement building, three flushing gutters, a lagoon and necessary pumps and piping. The open front pole frame building is 50 feet wide with 36 feet of pen area and 416 feet long. Flushing more frequently during the winter months minimizes the possibility of freezing in the 12 inch flumes beneath the 2 inch slats in the floor. The 250 feet by 500 feet lagoon with an aerator treats the waste for recycling into the flushing system. Some difficulties were overcome in starting the system in early winter when bacterial population in the lagoon were minimal and the weather cold. Animal density has been the key factor in keeping the manure moving on the floor to the flushing slat. Low cattle densities allow manure to build up and subsequently freeze to a depth of a foot over the slat whereas, higher cattle densities keep the floor clear. This case study shows that flushing systems are feasible, even in cold temperature regions of Minnesota when managed properly. (Natwick and Goodrich-Minnesota)

### 2613-B2, B4, E2, F1

### UTILIZATION OF BEEF CATTLE WASTE FROM A SLOTTED-FLOOR DEEP-PIT BARN,

Manager, Larson and Taylor Feedlot, Maple Park, Illinois; Department of Agricultural Engineering, Illinois University at Urbana-Champaign
R. Larson, D. G. Jedele
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 101-103.

Descriptors: Confinement pens, Illinois, Waste storage, Fertilizers.
Identifiers: Slotted floor deep pit barn, Tanks, Land disposal, Application rates.

Three thousand head of cattle are marketed and 1500 acres of crops are grown annually by 2 and one half full-time workers on the Larson and Taylor farm near Maple Park, Illinois. Manure from the cattle is collected in 8-ft. deep tanks beneath slotted floors. The tanks are partially emptied in late August after pea harvest, completely emptied after corn silage harvest and completely emptied again in the Spring. Pumping, hauling, and spreading this manure requires about forty man days, but is usually accomplished in twenty actual days. This leaves 345 days per year when the waste management system needs little or no attention. Two men using two 3200 gallon tank wagons and one pump can empty two of the seventeen 80,000 gallon manure tanks in a day with an average two-mile round trip to the crop land. The maximum length of haul is three miles round trip. Applications to the soil have been at the rates of 3,000, 6,000 and 10,000 gallons per acre. Soil testing has been done to determine the value of the manure as a replacement for commercial fertilizer. The 1974 crops are to be weighed at harvest time to compare the effectiveness of the nutrients in manure with the nutrients in commercial fertilizer. Experience from prior years and calculations based on current commercial fertilizer prices indicate that the manure may return as much as ten dollars per head of cattle marketed. This return could quickly pay for the higher construction cost of a deep-pit barn compared to other beef confinement barns that have waste management systems that do not utilize the nutrients in the manure. (Larson and Jedele-Illinois)

### 2614-A2, B2, B4, C2

### EVALUATION OF DAIRY, BEEF AND SWINE WASTE HANDLING SYSTEMS,

Extension Agricultural Engineer, Michigan State University
R. L. Maddex, T. L. Loudon, L. R. Prewitt, and C. H. Shubert

Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 104-106.

Descriptors: Livestock, Dairy industry, Confinement pens, Waste storage, Design, Agricultural runoff, Nutrients, Labor, Maintenance.
Identifiers: Waste handling, Waste accumulation rates.

A variety of systems for handling and storage of animal waste have been constructed in the last few years. Some of these have been designed by Soil Conservation Service personnel or Extension Agricultural Engineers, but others have been planned and built by farmers themselves often patterned after systems they have observed on other farms. A study to evaluate the design criteria, labor requirements, mechanical maintenance, and level of management associated with these systems has been initiated. Seven dairy farms were initially selected for waste management studies. Two of the farms are total confinement operations with the remaining five having a combination of free-stall and outside paved lots. All but one farm have manure storage facilities. Runoff collection ponds are in operation on each of the farms that have outside lots. The present project is being expanded to include additional dairy farms with different waste handling techniques as well as beef and swine facilities. The paper describes the waste handling techniques on each of the farms under study. Information will be reported on measurements of the rate of waste accumulation in storage facilities, nutrient content of the stored manure, and the relationship between precipitation and runoff from the various lots. The labor requirements and management techniques associated with the waste handling operations will be discussed. (Maddex, et. al-Michigan State University)

### 2615-B2,B4,F1

### LARGE PISTON MANURE PUMPS AND OUTSIDE MANURE STORAGES (EARTHEN BASINS),

Department of Agricultural Engineering, Wisconsin University, Madison
R. E. Graves
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 107-111.

Descriptors: Dairy industry, Pumped storage, Lagoons, Wisconsin, Equipment, Costs, Design.
Identifiers: Midwest U.S., Solid piston pump, Hollow piston pump.

Because storage tanks under dairy barns of barnyards have such problems as high construction costs, gases and odors, and ventilation problems, some midwest dairymen are turning to storage ponds and lagoons. In the past conveying manure to these structures by means of tractor scrapers of conventional manure handling equipment has had its inherent problems. In 1972, large piston manure pumps became commercially available in Wisconsin. These pumps provide an automatic method for manure removal from a barn to an outside storage structure. Manure may be conveyed through up to 200' of 10" or 12" pipe to the bottom of a storage area. The two variations in pumps are a "solid piston pump" which handles manure with or without long fibrous material, and a "hollow piston pump" which handles manure without long fibrous material. The hollow piston pump is cheaper and more readily available and is presently the most popular with free stall barns. This paper reports on experiences with these systems, particularly agitation and emptying of these rather large (100' to 200' ) earthen storage units. Various designs, pumping units and management methods are used. (Graves-Wisconsin University; Merryman, ed.)

### 2616-A5,A6,B2,C2,D1,E2,E3

### MILKING CENTER WASTE MANAGEMENT,

Department of Agricultural Engineering, Pennsylvania State University, University Park
H. D. Bartlett, A. E. Branding, L. F. Marriott, and M. D. Shaw.
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 112-113.

Descriptors: Dairy industry, Recycling, Irrigation, Effluent, Nitrates, Nutrients, Odor.
Identifiers: Waste management, Land disposal, Manure separation bed, Flushing, Groundwater quality.

A system was developed to manage the total waste from a 150 cow milking center (holding area, milking parlor and milk house). Pipeline cleaning water is recycled for parlor cleaning and parlor cleaning water is recycled for flushing the holding area. The manure is removed by an automatically controlled separation chamber which has been developed and the effluent is distributed by an automatically controlled irrigation system to agronomic land. The soil and crops were analyzed for nitrate-N build-up and nitrogen level, respectively, to determine maximum effluent application rates consistent with maintaining groundwater quality and safe nitrogen levels of forage grown on the effluent disposal area. A major innovative feature of the system is the manure separation bed that utilizes a combination of settling and screening principles which removes the fibrous components of the manure to render an effluent that will allow completely clog-free pump operation for automatic control. Manure is removed from the separation bed with a front-end-loader at three month intervals. The respective components (manure and effluent) were analyzed for crop nutrient value and odor quality. (Bartlett, et. al.-Pennsylvania State University)

### 2617-B2,B3,C1,C2,D1,D3, E2,E3

### WASTE MANAGEMENT AT HALL BROTHERS DAIRY,

Extension Agricultural Engineer, Auburn University, Auburn, Alabama
H. Watson, H. E. Hamilton, D. Hall and T. McCabe
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 114-116.

Descriptors: Dairy industry, Confinement pens, Separation techniques, Recycling, Lagoons, Aerobic condition, Anaerobic conditions, Irrigation.
Identifiers: Flushing, Screening, Solids removal.

Hall Brothers Dairy, located near Snowdoun, Alabama, is a 1200-cow total confinement system. Automated flush type manure handling is an integral part of the operation. Manure is removed from the milking parlor, holding lot area, and feed and housing areas by flushing with high volumes of water during each milking period. The estimated water requirement for the system is approximately 125,000 gallons per day. Manure laden flush-water from the system is collected in two 8000-gal. underground collection tanks. A 10-horsepower agitator stirs the material while it is being pumped over a gravity flow type screen. Solids removed by the screen are collected in a concrete pit located below the machine. Preliminary analysis of the solids removed by the screen indicate that the solids have a moisture content of approximately 80 per cent and contain approximately 3 per cent protein. These separated solids have many potential uses. Recycling as feed for cattle, bedding for the free stalls, and field spreading have all been tried on an experimental basis at Hall Brothers Dairy. Additional tests and analyses are being conducted to determine the value of this material as a feed ingredient, as bedding and as fertilizer. Water leaving the screen is processed through a 3-cell lagoon system where both anaerobic and aerobic processes further reduce its pollution potential. Overflow from the lagoon system is controlled through the use of an irrigation system installed between the second and third cells. Effluent in the lagoons is used for irrigation during periods of low rainfall, allowing the lagoons to collect runoff and flush water during the winter months. Further study is under way. (Watson, et. al.-Alabama; Merryman, ed.)

### 2618-A4,B2,B4,E2,E3,F2

### ADAPTATION OF A BRITISH WASTE MANAGEMENT SYSTEM TO THE U.S. ENVIRONMENT,

Howard Harvestore, Ltd. Saxham, Bury St. Edmunds, Suffolk, England
P. Jensen, G. Newman, and A. J. Peters
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 117-120.

Descriptors: Waste storage, Slurries, Design, Testing.
Identifiers: Waste management, United Kingdom, Harvestore.

In the United Kingdom extensive and increasing use is being made of livestock waste management systems which feature above ground storage of liquid manure during seasons of the year when spreading on fields is either impossible because of bad weather or impractical because of poor timing for fertilizer application. Two factors have stimulated this activity—anti pollution legislation and the rapidly increasing cost of chemical fertilizers. Howard Harvestore, Ltd., joint venture partner of A. O. Smith Harvestore Products, Inc., has been notably successful in the application of open top, above ground liquid manure storage vessels, called slurrystores, made of glass-coated steel Harvestore sheets. Their success in the U.K. environment has prompted much interest on the part of U.S. Harvestore dealers who want to apply the same kind of equipment to livestock pollution control in the U.S. Therefore a product design and development project, reported here, was set up with the purpose of testing the suitability of the slurrystore system in the U.S. environment, where seasonal temperatures both far above and far below the norm in England might make direct adaptation of the English system difficult. During the winter and spring of 1974, operational testing was conducted with four prototype systems, including two in Wisconsin, one in Missouri and one in Texas, with a variety of types and makes of pumps for loading, recirculating (agitating) and unloading the Slurrystore structures. Some unexpected problems did arise but have been successfully resolved and the general conclusion of this work is that the above ground Slurrystore system, properly equipped and managed, can solve the farmer's waste management problem, prevent pollution of streams, and provide a significant new application of Harvestore equipment to America's animal agriculture. (Jensen, et. al.-England and Illinois; Merryman, ed.)

### 2619-A2, A7, B2, B4, E2

### A LIQUID MANURE MANAGEMENT SYSTEM IN A TIE STALL DAIRY BARN,

Dairyman, Rolling Hills Farm, Watkins, Minnesota; Department of Agricultural Engineering, Minnesota University, St. Paul, respectively
G. S. Meierhofer, and P. R. Goodrich
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 121-122.

Descriptors: Liquid wastes, Dairy industry, Design, Waste storage.
Identifiers: Land disposal, Tie stall dairy barn.

Joining a tie stall dairy barn to a liquid manure system was the objective of the Meierhofer dairy facility.

Efficient and timely collection, storage and utilization of the dairy manure, milking house waste, and exercise lot runoff was needed. For a total pollution control system two separate pits were used. A 30 foot by 32 foot pit beneath a pole barn is covered with a slotted floor. Manure from the young stock housed in the pole barn and runoff mixed with manure from the exercise lot are scraped into this pit. During suitable field spreading conditions, this tank is agitated, pumped and spread using a liquid manure tank. The bulk of the waste is handled in the pit beneath a two year old tie stall barn. Four compartments allow for agitation by sections when pumping out. The pit is offset 6 feet, so that there is no pit under 6 feet of feed alley in front of the cows on one side, but the pit extends 6 feet beyond the building on the other side. This offset allows easy access for agitating and pumping. Ventilation fans are permanently located on the offset and may be used during agitation to reduce the hazard of noxious gasses in the building. Most pumping ports require the fans to be removed to put the pump in. Gutters behind the cows in the tie stalls are equipped with grates so the manure will drop into the pit, yet protect the animal. The system has been in operation two years with excellent results. The four day pit cleaning process can be done when the land is not frozen. For a dairyman who prefers tie stalls to slotted floor and free stalls, this system has worked well. (Meierhofer and Goodrich-Minnesota; Merryman, ed.)

### 2620-A6,B1,B2,B4,E2

### A COMPLETE DAIRY LIQUID MANURE SYSTEM,

Biological and Agricultural Engineering Department, Rutgers University, New Brunswick, New Jersey 08903
W. J. Roberts, M. E. Singley, and D. R. Mears
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 123-125.

Descriptors: Dairy industry, Liquid wastes, Waste storage, Ventilation, Odor.
Identifiers: Land disposal.

A complete liquid manure handling system was one objective of a 40-cow innovative dairy research facility. Liquid manure handling, free choice stalls and self feeding of silage create a relatively labor-free system with minimum energy and machinery requirements. All equipment operations occur outside the area of freedom given to the animals. The liquid manure collection and storage system includes a circular slotted manure trench 4 feet deep, a pump and a large external holding tank with the pumping port and ventilation equipment located on the tank top. The manure system forms part of the ventilation system which controls moisture, temperature and odors and gases produced in the trench. The trench is located between the circular feeding platform and the outer ring of free stalls. The trench is flushed by recirculating material from the holding tank. Manure pumped into a closed transport is incorporated directly into the soil in one operation by using the plow-furrow-cover technique. The performance of the ventilation system in conjunction with the manure system is outstanding. Malodors are only present at the ventilation outlet during the flushing operation pumpout. Methods have been evaluated for treating the exhaust air at these times with oxidizing agents. Corrosion of the ventilation equipment, louvers, and fans, is a severe problem. The liquid manure system has worked well for an extended period of time. (Roberts, et. al.-Rutgers Univ.; Merryman, ed.)

### 2621-A2,A6,B2,B4,D3,E2

### A WASTE MANAGEMENT SYSTEM FOR A 150-COW DAIRY—A 10-YEAR CASE STUDY,

Department of Agricultural Engineering, Purdue University, West Layfayette, Indiana
A. C. Dale, J. L. Albright, J. C. Nye, and A. L. Sutton
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 126-129.

Descriptors: Dairy industry, Lagoons, Irrigation, Clogging, Pumping.
Identifiers: Waste handling.

Some of the problems and successes of the waste handling facilities at the 150-cow Purdue Dairy Farm Center are described. Odor complaints and large labor load caused the farm to modify their solid waste handling facilities so that all wastes could be handled as a liquid. Two 34,000 gallon circular concrete holding pits were constructed. The manure was scraped to these holding pits, diluted with water, mixed and pumped with an impeller manure pump and hauled to nearby fields for disposal. However, odor was still a problem. Further measures were taken through the years. A small sedimentation lagoon was constructed to control excess runoff. An aerator was placed in it to control odors. Later, a large anaerobic lagoon was constructed which received all the wastes. It was dewatered annually by conventional irrigation equipment. However rapid increase in solids level caused clogging problems in the nozzles. In 1973, a large 40 hp pump was employed to drive the irrigation system. It also developed clogging problems. The final solution for dewatering the lagoon was two pumps in series. The first pump was a large capacity trash pump; the second was the 40 hp unit already discussed. Experience with this system led to several conclusions. Material which will not decompose should not be added to lagoons to be used with irrigation systems. If mechanical and hydraulic devices are to be employed, some method of keeping the large non-biodegradable particles out of the waste is necessary. A solid waste handling should still be used for handling the lot scrapings particularly if bedding is used with large particles in it. If these large solid materials are removed, the lagoon system with irrigation dewatering works well for handling the dairy lot runoff. (Dale, et. al.-Purdue University; Merryman, ed.)

### 2622-A6,B2,B4,D3,E2,F1

### SELF UNLOADING PITS IN A DAIRY MANURE MANAGEMENT SYSTEM,

Dairymen, Litchfield, Minnesota; Department of Agricultural Engineering, Minnesota University, St. Paul
W. R. E. Euerle, G. O. Euerle, and P. R. Goodrich
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 130-131.

Descriptors. Waste storage, Waste disposal, Dairy industry, Lagoons, Costs, Labor, Sprinkler irrigation.
Identifiers: Land disposal.

Short term storage of daily manure beneath slats coupled with pull gates on the pits for emptying into a lagoon minimize cost and labor in this system. A high capacity sprinkler system removes the waste from the lagoon at infrequent intervals for recycling onto land. Brothers, William and Gerald Euerle find that the system is easy to operate and effectively controls the waste from a 75 cow freestall operation. Utilizing an elevated location for the barn about 50 feet from a detention pond, they collect the manure and milking parlor waste in a pit beneath the barn. The pit has storage capacity for about 2 months. Cleaning is done by lifting a wooden gate at the end of the north portion of the 3 section pit. This forces the fairly liquid portion of the waste in the section beneath the feed bunk to flush first, the south section and then, the north section. The flowing material clears the solids well and moves to the lagoon down a channel in the hill slope. Anaerobic action in the lagoon has not forced ducks to leave and has not given off objectionable odors. Solids have not filled the lagoons to an extent to require cleaning. The self-powered moving big gun sprinkler and centrifugal pump move the liquids to final disposal on nearby fields very quickly. The total system recycles the manure with low labor cost and without excessive investment cost. Daily winter spreading and its environmental hazards have been eliminated. (Euerle, et. al.-Minnesota)

### 2623-A4,A5,B1,C2,D3,E2, F2

### A PLANNING STUDY ON DAIRY WASTES MANAGEMENT,

Vice President, Albert A. Webb Associates, 3788 McCray Street, Riverside, California 92506
S. I. Gershon, S. A. Hart, A. C. Chang, and J. W. Branch, Jr.
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 132-135.

Descriptors: Dairy industry, California, Water pollution, Groundwater pollution, Salts, Regulation.
Identifiers: Land disposal, Compost, Evaluation.

The major milkshed for Los Angeles, California is in the Chino Basin of the Santa Ana River Watershed, 25 miles east of Los Angeles. Approximately 165,000 dairy cows are located within a 120 square mile area. The manure from these animals is either applied to nearby farm fields or exported as "compost." Nevertheless, mismanagement of waste storage and disposal contributes to surface and groundwater pollution problems. Concern about water pollution prompted the Santa Ana Watershed Planning Agency to retain consultants to study and recommend various management plans, including waste handling from various pollutant contributors. In one such study, the consultants hoped to determine economically feasible methods by which the dairy industry could reduce the amount of "salts added" (about 50,000 tons of salt—total dissolved solids—per year) to the groundwater basin from the dairy industry by 90 per cent. An extensive data-gathering program was initiated. The extent of the salt problem was determined. Alternative means of collection, treatment, and disposal of the waste streams were evaluated. An economic analysis of the feasible alternative methods was made along with recommending a plan. Study results are given in detail. (Gershon-Albert A. Webb Associates; Merryman, ed.)

### 2624-B3, C1, D1, E3, F1

### DAIRY WASTE FIBER—A BYPRODUCT WITH A FUTURE?,

Extension Agricultural Engineer, California University, Riverside
W. C. Fairbank, S. E. Bishop, and A. C. Chang
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 136-138.

Descriptors: Dairy industry, Separation techniques, Recycling, Litter, Soil amendments.
Identifiers: Dairy waste fiber, Hydromulching, Refeeding.

The dairy industry of California has for years enjoyed labor saving benefits of flush cleaning of manured concrete areas. In 1967 mechanical separators to screen coarse suspended particles and fiber from the liquid waste entered the scene. By 1972 large volumes of dairy waste fiber (DWF) were in neat storage piles throughout our dairy regions. Potential values in DWF were sought by two routes of investigation: (1) Consider the natural fibrous products in agricultural use, and compare by cursory evaluation the gross similarities and differences of DWF; (2) Examine DWF in sundried, sanitized, size fractionated form, and ascribe component values based on competitive materials. Related production techniques for handling, processing, packaging and merchandizing were concurrently developed in light of increasing energy costs and greater socio-environmental regard. Solar drying of wastewater saturated DWF in a thin bed and with daily tractor stirring was confirmed. Decomposition was arrested and an innocuous product resulted. Dry classification by mechanical screen into three particle sizes produced material of remarkable uniformity and appearance. The course grade appears suitable for any common agricultural use of wood shavings such as livestock litter. The middle size fraction appears of interest to the hydromulching industry as a low cost substitute for wood pulp fiber. The fine grade contains most of the residual and secondary digestible protein which suggests it be directed to feed ingredient use. All grades have been blended into commercial manure-based planter mixes and have been substituted for peat moss or wood shavings for general horticultural use. Environmental impact is nil, energy balance positive, economics and public acceptance favorable. (Fairbank, et. al.-Riverside, California; Merryman, ed.)

### 2625-A6, B2, B4, E2, F1

## THE DAKOTA SYSTEM—A METHOD OF COLLECTING, STORING, AND HANDLING ANIMAL WASTE,

USDA, SCS, Box 878, Bismarck, North Dakota
D. F. Meyer
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 139-140.

Descriptors: Dairy industry, Liquid wastes, Slurries, Waste storage, Design, Pumped storage.
Identifiers: Dakota System, Land disposal.

The Dakota System is a slurry or liquid manure handling system. By definition, waste having more than 96 per cent water is liquid manure, 80-95 per cent water is slurry (after proper agitation), and less than 80 per cent water is semi-solid. The Dakota System is primarily used in free stall dairies. The system includes a concrete tank with a capacity of seven days storage. A chopper pump requiring sixty horse-power or more connected to a ten or twelve inch P.V.C. pipeline conveys the waste to an earth holding pit which has a storage capacity of 180 days. Side slopes are one to one and end slopes are four to one. The Dakota System enables the dairy man to maintain sanitary conditions in all but the most severe weather. Odor is minimal because the seven day storage does not allow substantial biodegradation. A single chopper type pump enables the operator to empty the concrete pit, agitate the outside pit and load honey wagons for removal to the field. Surface of the earth holding pit generally freezes during winter. It remains frozen for a period of several days to a few weeks after spring break-up, helping keep the manure in good condition. Installation costs are kept low by utilizing a single pump. Waste water from the milking parlor is discharged directly into the concrete tank. This eliminates a waste problem and increases liquid content during periods of high evaporation to improve pumpability of the slurry. A recent pump trailer design eliminates pumping port, reducing costs and increasing flexibility for agitation. (Meyer, USDA; Merryman, ed.)

### 2626-A4, B2, B4, E2, F1

## MANURE PONDS FOR MINIMIZING POLLUTION,

District Conservationist, Soil Conservation Service, Kewaunee, Wisconsin 54216
A. C. Marini, O. J. Berry, and M. L. Knabach
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 141-143.

Descriptors: Wisconsin, Dairy industry, Costs, Design, Waste storage, Equipment, Water pollution.
Identifiers: Waste handling, Land disposal.

Wisconsin has long been noted for the production of dairy products. Throughout the years, the size of the dairy farms has steadily increased. However, the proximity of many of the livestock yards to perennial streams, many of which are trout streams, has not changed. As a result, the larger herds have increased the problem of handling the large volumes of manure produced each day. One method of handling these livestock wastes which has become very popular in some sections of the state involves the use of manure pumps. Although the number of companies which fabricate manure pumps are few, a considerable number of these types of installations have been made. Many of these systems have been very successful. The manure has been removed from the buildings and successfully stored for the desired period of time while greatly reducing surface water pollution. This paper describes the design and operation of a complete manure handling system for a farm located in Kewaunee County. Although the total cost of this system was relatively inexpensive, the capacity is sufficiently large to store the total manure accumulation of 100 cattle for the entire winter season. The paper covers three major items: (1) the design of the overall waste management system, (2) the operation of the system including the application of the animal wastes onto the land in a manner which eliminates pollution, and (3) the equipment used and a description of the storage facilities which effectively use earth embankments to store the waste. (Marini, et. al.-Wisconsin; Merryman, ed.)

### 2627-B2,B3,B4,C1,C2,D1,D3 E2,E3,F5

## A TOTAL RECYCLE UNIT SYSTEM FOR DAIRY MANURE MANAGEMENT,

Department of Agricultural Engineering, Purdue University, West Lafayette, Indiana
A. C. Dale and R. Swanson
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 144-146.

Descriptors: Recycling, Dairy industry, Waste treatment, Slurries, Fertilizers.
Identifiers: Pollution control, Bedding, Soil conditioner, Refeeding.

This paper describes the Total Recycle Unit (TRU) System, developed by Babson Bros. Co., Oak Brook, Illinois, to mechanically handle and treat dairy cow manure. With the TRU System, part of the manure is converted to readily reusable products and the remainder is converted into non-pollutional end products. A field trial unit is undergoing final observations and monitoring prior to tooling up for production in the near future. The complete TRU System processes raw dairy cow manure as follows: (1) homogenizes the manure into a slurry in a primary collection tank, (2) pumps the slurry through a solids-liquid separator, (3) washes the first separated solids with "clean" water to further remove mucous and dissolved solids, (4) ejects washed and final separated solids to a storage for use as bedding, as a soil conditioner, or for refeeding to beef cattle, (5) returns some liquids to the mixing tank to dilute the incoming manure, (6) pumps the remaining liquid to the following: (a.) a storage for holding until irrigated onto cropland, (b.) an aerator and thence to an electroflocculator for removal of minerals, (7) pumps the colored water through a clarifier producing a clear reusable or dischargeable water. In summary, the complete TRU System produces "clean" solids, concentrated fertilizer and clarified water from dairy cow manure. However, only part of the system may be selected. For example, the electroflocculator could be eliminated with the liquid going directly to the holding unit for eventual use as a fertilizer or a substrate for bacteria for synthesize into proteins. (Dale and Swanson-Purdue University)

### 2628-A6,A8,B2,B4,C2,E2

## SUCCESSFUL MANURE MANAGEMENT SYSTEM FOR A LARGE COMMERCIAL HOG OPERATION,

Gehlbach Pork Farm, Lincoln, Illinois; Extension Agricultural Engineer, University of Illinois, Urbana
G. D. Gehlbach and A. J. Muehling
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 147-149.

Descriptors: Waste storage, Lagoons, Fertilizers, Phosphorus, Crop response.
Identifiers: Swine, Waste management, Land disposal, Slotted floors.

Gehlbach Pork Farm in Logan County, Illinois, markets approximately 8,500 hogs per year. As this hog operation has increased, a major concern has been to develop an acceptable waste handling system. All hogs except the breeding herd are raised in confinement under roof. Most buildings are fully slotted with storage pits underneath which provide 3-5 months storage. Manure is disposed of in two ways: (1) hauling from the pits with a vacuum tank wagon with soil-injection attachment and chiseled in the ground for fertilizer, and (2) lagooning. This results in almost odor-free disposal of the manure. The pits are emptied completely in the fall before freezing. As much manure as possible is hauled in the spring before the corn is planted, occasionally resulting in some late planting. A small amount of land is left idle through the summer for manure disposal. The scarcity and price of commercial fertilizer is encouraging better distribution, and application is being made on the most nutrient deficient soils. A 7 and one half acre lagoon is a backup and used for overflow only when the pits fill up. The lagoon is pumped down when necessary to keep it from overflowing. Comparisons of land receiving commercial fertilizers with land receiving manure indicate that in the latter extremely high values of phosphorus occur, but yields don't seem to be affected. This could be classified as one successful method of handling swine wastes on a large commercial farm. (Gehlbach and Muehling-Illinois; Merryman, ed.)

### 2629-B2, E2, E3, F1

## EXPERIENCE WITH OPEN GUTTER FLUSH SYSTEMS FOR SWINE MANURE MANAGEMENT,

Department of Agricultural Engineering, Maryland University, College Park
H. L. Brodie
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 150-153.

Descriptors: Confinement pens, Maryland, Economics, Design, Lagoons, Recycling, Irrigation.
Identifiers: Swine, Waste management, Open gutter flush system.

Several swine producers in Maryland have constructed new confinement facilities for swine utilizing the open gutter flush system for manure collection and transport. Two different farms are examined to determine the overall economic, management, labor and production efficiencies of this waste management system. The experiences of construction, operation, and management are reviewed. On one farm a 250 foot long swine finishing building and a 120 foot long gestation building are flushed. The gutters are four feet wide by four inches deep with floor slopes of one and two per cent. Waste water enters a three-fourth acre lagoon from which water is recycled for flushing. All structures were constructed with farm labor. The second farm flushes a 250 foot long finishing house utilizing a four foot wide by four inch deep gutter. Waste water is collected in a liquid manure tank and spray irrigated on nearby grassland. Well water is used for flushing. The structure was completely constructed with contracted labor. Two different designs of automatic dumping hopper type flush tanks are in use. The development of water use practices is dependent on the disposal method. Strict conservation is observed for the spray irrigation system. However, the lagoon system uses a great volume of recycled water. Both systems work satisfactorily. The labor and management input into the waste handling system is significantly reduced without an excessive investment cost. (Brodie-Maryland University; Merryman, ed.)

## 2630-B1,C1,C2,E2,F1,F4

### SWINE PRODUCTION AND WASTE MANAGEMENT: STATE-OF-THE-ART,

Biological and Agricultural Engineering, North Carolina State University, Raleigh
M. R. Overcash, F. J. Humenik, and L. B. Driggers
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 154-159.

Descriptors: Swine, Economics.
Identifiers: State of the art, Waste management, Pork production.

An exhaustive review of over 100 pertinent articles has been compiled in association with an EPA grant to critically evaluate the composite production-waste management strategies in the United States. A comprehensive systematic survey of the pork production industry was also conducted to add dimension to assessment of actual producer operations and problems relative to waste management options. This combined literature review and survey as a state-of-the-art review can provide excellent direction for future regulations and pork industry growth patterns. Information from literature references, extensive data retrievals and calculations have put the available waste characterization data on a uniform and thus more useable basis. The raw waste load and waste stream from various composite production-pretreatment systems are included for such parameters as liquid volume, COD, TOC, TKN, $NH_3$-N, $PO_4$-P, solids, K and trace elements. Finally a regrouping of traditional production systems to reflect waste management considerations and economic costs for final application to plant-soil receiver systems is included. Such unit definition ranges from those with large volumes of wastewater or high nitrogen contents to those with minimal water and nitrogen in the waste stream. A discussion of the minimum cost effective parameters which could be monitored to evaluate or regulate performance of a waste management system with a terminal plant soil receiver system is included. (Overcash, et. al.-North Carolina State Univ.)

## 2631-A6,B2,D1,D3,E3,F5

### SWINE WASTE NUTRIENT RECOVERY SYSTEM BASED ON THE USE OF THERMAL DISCHARGES,

Department of Agricultural Engineering, Oregon State University, Corvallis
J. R. Miner, L. Boersma, J. E. Oldfield and H. K. Phinney
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 160-163.

Descriptors: Recycling, Anaerobic digestion, Algae, Methane, Design.
Identifiers: Swine, Nutrient recovery system, Thermal discharges, Single cell protein, Waste water reuse.

The feasibility of using waste heat from steam electric plants to sustain a food producing complex in which nutrients are recycled is being analyzed. Microorganisms are being used to convert animal manures into a high protein livestock feed and a methane rich fuel gas. Waste heat from the steam electric plants is used as a low cost source of energy for maintaining stable, elevated temperatures in anaerobic digestion and single cell protein production units. Much of the technology of the individual units is currently available. The objective of this project was to develop a system utilizing these units together and to establish design and operating criteria. The system consists of anaerobic digestion for liquifaction of solid material and soluble nutrient recovery by growing algae in basins heated with waste heat. The components of the system include: hydraulic manure transport, a solid-liquid separator, an anaerobic digester, aerobic basins for growing algae, harvesting equipment, and a soil-bed filter system for final removal of nutrients. The nutrient requirements of algae cultures are similar to the waste characteristics from swine. The design of the facility is based on the waste production of fifty swine. The facility is a livestock confinement building where the manure is flushed from the animal pens and routed to the nutrient recovery system. Flushing is done with sufficient frequency to prevent anaerobic decomposition and associated odors within the building. Clarified liquid from the nutrient recovery system is re-used in the process to flush wastes from the building. (Miner, et. al.-Oregon St. Univ.; Merryman, ed.)

## 2632-A2,A5,A6,A10,A11,B2, D3,E2

### MANAGING A SUCCESSFUL LIQUID SWINE MANURE MANAGEMENT SYSTEM,

President, Leanco Corporation, P.O. Box 879, Brownwood, Texas 76801
P. R. George, J. M. Sweeten, and S. J. Buchanan
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 164-167.

Descriptors: Liquid wastes, Waste treatment, Lagoons.
Identifiers: Swine, Storage pits, Land disposal.

A modern 600-sow farrow to finish operation in Central Texas employs a three-phase system of efficiently managing liquid swine manure. This system has proven itself through legal battles and serves as a model for the swine industry in Texas. The feeding system consists of two enclosed farrowing houses; two adjoining nurseries and eleven partially-covered finishing buildings. The two enclosed slatted-floor farrowing houses are underlain by ventilated 4' deep liquid manure storage pits. Separate storage pits are provided for each 30-sow room within the farrowing house to facilitate clean-out and enhance disease control. In all other buildings, liquid manure pits (beneath fully and partially-slatted floors) extend the length of the buildings. Anaerobic treatment is provided in these continuous flow storage pits, which have a theoretical manure storage capacity (detention time) of 70 days. Through experience, the operators have arrived at a program of withdrawing settled solids from the storage pits without agitation at two to three week intervals using honey wagons. This method of sludge handling was compared with chemical treatment of the pits from the standpoint of odor control; results will be reported. Sludge is hauled to adjacent fields and disposed of through plow-furrow-cover. Odors and flies are effectively controlled. No additional fertilizer is needed on the 100 acres of Coastal Bermudagrass pasture. Finally, liquid overflow from the manure storage pits is conveyed one half mile into a facultative-anaerobic lagoon for further treatment and eventual land disposal. This lagoon also receives runoff from the 100-acre solids disposal area and is designed to contain the 25 year frequency, 24 hour duration storm. Besides meeting the zero-discharge standard for both the feeding area and manure disposal area, the operation has been monitored for possible groundwater pollution problems. To date, piezometers have indicated no evidence of seepage from either the lagoons or from the liquid manure storage pits. (George, et. al.-Texas; Merryman, ed.)

## 2633-B2,B4,C2,D3,F2,F1

### TOTAL WASTE MANAGEMENT FOR A LARGE SWINE PRODUCTION FACILITY,

Manager, Lexington Swine Breeder, North Carolina
F. J. Humenik, R. E. Sneed, M. R. Overcash, J. C. Barker, and G. D. Wetherill
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 168-171.

Descriptors: Costs, Sprinkler irrigation, Ammonia.
Identifiers: Swine, Waste management, Land disposal, Zero discharge, Volatilization, Aerated basin, Anaerobic lagoon.

Consistent with developing animal waste management technology, this total system is centered around nitrogen and the pretreatment processes prior to terminal land application for the most feasible approach to a zero discharge system. The maximum production capacity of this breeder facility is about 200,000 lb on-farm liveweight. Facilities have been developed to minimize wastewater generation in the totally enclosed buildings with manure storage pits under partially slatted floors. Site alterations included creek rerouting to optimize the production-waste management system. Wastewater pretreatment processes are a surface aerated basin (87,000 $ft^3$) followed by an unaerated anaerobic lagoon. In addition, liquid from the unaerated lagoon is applied to a 1.5 acre site in which overland flow pretreatment is accomplished with this wastewater returning to the unaerated lagoon. Piping in conjunction with the overland flow and terminal irrigation system also allows use of secondary lagoon water for pit precharge and positive cleaning after pit emptying. These pretreatment processes effect nitrogen losses by ammonia volatilization and nitrification-denitrification as well as some degree of odor control. Final treatment or disposal of lagoon effluent is accomplished by a permanent set sprinkler system with manual control of laterals. The operational strategy, installation costs, and on-going costs are included. (Humenik, et. al.-North Carolina)

## 2634-A6,A10,A11,B1,B2, B4,F1

### SIMPLIFYING MANURE HANDLING IN A SOLID-FLOOR SWINE HOUSING SYSTEM,

Farmer, R. R. 1, Monona, Iowa 52159
D. J. Meyer
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 172-173.

Descriptors: Design, Costs, Labor.
Identifiers: Swine, Waste management.

There are basically three types of liquid wastes systems being used in swine operations: (1) long-term pit storage, (2) inside treatment systems, and (3) systems that flush manure outside. Although these systems keep labor input low, there are drawbacks depending on the system chosen. The purpose of this paper is to present a building design which eliminates most of these drawbacks and yet has a low labor input. Specifically, the objectives were to: (1) minimize disease build-up, (2) minimize odor and flies, and (3) keep the costs low. The building design follows: The building is bounded by a generally-circular upright wall covered by a roof. Centrally located is a pit for receiving liquid and solid wastes. An annular imperforated floor extends outward from the pit toward the wall and is exposed for direct access to and walking upon, by the hogs. An elongated sweep means radially extends from a pivotal mount at the pit center for lateral movement around and over the floor in order to engage the solid wastes on the floor and propel them towards and into the pit. Surrounding the swept floor, but still within the enclosure, is a nesting region. For inducing the hogs to defecate only on the swept floor, (1) the nesting region is raised above the level of the swept floor, and (2) air circulation occurs so as to encourage the livestock to respect their nesting region. The building and waste system described were constructed and are currently in operation. (Meyer-Iowa; Merryman, ed.)

## 2635-B2, D3, F1

### DOUBLE E. FARMS—SWINE INSTALLATION,

Owner and Operator of Double E Farms, 37 North Sylvan Avenue, Columbus, Ohio 43204
T. W. Eisenman and R. K. White
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 174-176.

Descriptors: Design, Lagoons, Costs, Equipment, Maintenance costs, Ohio.
Identifiers: Swine production.

The swine installation of the Double E Farm is located approximately 18 miles Southwest of Columbus, Ohio. The installation consists of the following: (1) Six outdoor breeding pens, each 145' x 35', (2) Gestation building, 292' x 23', (3) Farrowing and nursery building, 267' x 21', (4) Finishing building, 271' x 37', (5) Liquid waste lagoon, with a water area of 4.63 acre and a depth of 5'. Some of the major difficulties encountered since the system was put into operation are: (1) Unsatisfactory voltage conditions and high cost of electric energy due to physical location of installation with relation to electric energy supply source, (2) Aerator wheels were constructed of light gage material which resulted in a great deal of breakage. All wheels were rebuilt of heavy gage material, (3) Hog hair collected in wheel bearings causing many shut downs, (4) It was necessary to dilute liquid in building trenches by recirculating water from the lagoon, (5) Undigested oat husks built up a residue in the trench bottoms, (6) Sand from pre-mixed feed caused a build up in the trenches, (7) Over current relays were installed to protect the wheel motors from burn outs, (8) There were numerous belt breakages on the wheels. Under current relays were installed in the wheel motor circuits to sound an alarm when this condition occurred, (9) A buildup on the wheels of ammonium magnesium sulfate, (10) Aerob-A-Jet units were tested in lieu of aerator wheels but did not seem to do a satisfactory job, (11) Maintenance of equipment and inside of buildings is very costly. (Eisenman and White-Ohio; Merryman, ed.)

## 2636-B2, D3, E2, F1

### A WASTE MANAGEMENT SYSTEM FOR A 2500-HEAD SWINE OPERATION–A CASE STUDY,

Department of Animal Sciences, Purdue University, West Lafayette
A. L. Sutton, D. H. Bache, J. T. Nye, A. C. Dale, D. D. Jones, et. al.
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 177-180.

Descriptors: Liquid wastes, Design, Costs, Lagoons, Anaerobic conditions, Irrigation.
Identifiers: Swine, Waste management, Oxidation ditch, Slatted floors, Land disposal.

This study (1) describes the design and (2) reports on the performance of a liquid waste management system for a 2500-head swine operation at the Baker-Purdue Animal Sciences Center, Purdue University, West Lafayette, Indiana. The farrow-to-finish operation includes two 800-head environmentally regulated confinement growing-finishing houses, two 48-crate environmentally regulated confinement farrowing houses, and two 120-head open-front confinement gestation houses. Four-foot deep race track-shaped oxidation ditches are located in the finishing and farrowing houses to collect, store and treat wastes. A four-foot anaerobic pit beneath a partially slatted floor collects and stores waste from sows in the gestation houses. Waste from all pits beneath the slatted floors is transported by gravity to a 2000-gallon sump tank system. The liquid waste is automatically pumped from the sump into an anaerobic lagoon with a submersible 3-hp electric vertical cantiliver high solids pump. Lagoon effluent is irrigated on adjacent land cropped to continuous corn. Investment and operating costs and labor requirements of the lagoon-irrigation system (tiling, sump, lagoon, irrigation) were compared to the liquid tanker wagon hauling system. Initial investment costs were higher for the lagoon-irrigation system. However, the lagoon-irrigation system required much less labor. Yearly operating and labor costs for the liquid hauling system were higher than the lagoon-irrigation system. It was concluded from this study that the lagoon-irrigation waste disposal system can be an attractive alternative for a large swine waste operation. (Sutton, et. al.-Purdue University; Merryman, ed.)

## 2637-A6, B2, D1, D3, E2

### KSU AEROBIC SWINE WASTE HANDLING SYSTEM (SIX YEARS OF PROBLEMS AND PROGRESS),

Department of Animal Science and Industry, Kansas State University, Manhattan 66506
B. A. Koch, R. H. Hines, G. L. Allee, and R. I. Lipper
Managing Livestock wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 181-183.

Descriptors: Aerobic treatment.
Identifiers: Swine, Foaming, Maintenance, Aerob-A-Jets, Land disposal, Holding tanks.

Aerobic oxidation was the method of waste disposal built into new swine production facilities at K.S.U. in 1968. The system has been used continuously and is functioning successfully. A 29-stall farrowing house sits over a racetrack pit 80 feet long (one side) by 8 feet wide and 4 feet deep (the septic tank from the headquarters building drains directly into this pit). The nursery sits over two similar pits each 80 feet by 4 feet wide and 4 feet deep. Each of two finishing barns sits over a racetrack pit 104 feet long (one wide) by 8 feet wide and 4 feet deep. Liquid level is maintained constant in each pit by a standpipe which drains into an outside holding tank. Holding tank fluid is hauled to farm fields with a tractor and a liquid manure wagon. The pits were originally equipped with paddle wheels, but foaming and maintenance problems led to the installation in late 1971 and early 1972 of Fairfield Aerob-A-Jets. At that time pits in the finishing barns were drained and cleaned because of excessive build-up of solids. Pits in the farrowing house and nursery have never been cleaned except for fluid that overflows from the standpipe. Data collected since the installation of the "Jets" includes: power consumption, fluid temperature, fluid pH, fluid dry matter, dry matter composition, and amounts of fluid overflowing from the pits. Records show that maintenance of "Jets" has been minimal. Observations indicate that odor levels were low and recently have been reduced almost to zero by daily use of small quantities of a commercial product (Puritan Live Microorganisms) in each pit. (Koch, et. al.-Kansas State University; Merryman, ed.)

## 2638-B2, D1, D3, E2

### TWO-STAGE ACTIVATED SLUDGE TREATMENT OF EFFLUENT FROM INDUSTRIAL HOG BREEDING FARMS,

Institute for Water Management, Bucharest, Spl. Independentei 294, Romania
C. A. L. Negulescu
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 184-185.

Descriptors: Activated sludge, Waste treatment.
Identifiers: Swine, Romania.

One of the problems which may be solved by the activated-sludge process is the treatment of effluents from industrial hog breeding farms. During the last years, Romania has applied the system to breed hogs on a large number of capita on a very limited area (structures of agro-industrial type amounting 100-150 thousands hogs). Since the waste disposal by land-spreading requires a large agricultural area, the possibility to treat and dispose the waste has been taken into consideration. Our studies started with the characterization of wastes; the results obtained have been given as specific load (per capita). After few treatment plants built on mechanical and natural-biological treatment, the severe discharge conditions in some parts of the country obilged us to try more efficient methods of treatment. The conventional methods used in sewage treatment have been tried with good results. On laboratory scale (1970) and on full-scale (1972-73) we tried the hog waste settling followed by two stage activiated-sludge treatment. The results were very hopeful (more than 95 per cent efficiency) and upgrading these first plants, we hope to improve them. (Negulescu-Romania)

## 2639-A4,A5,A6,A7,B2,B3, D1,D3,E2

### A PIG SLURRY TREATMENT SYSTEM BASED ON SEPARATION BEFORE AEROBIC TREATMENT AND SLUDGE DE-WATERING,

Farm Buildings Department, National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedford, England
R. Q. Hepherd and L. E. Osborne
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 186-189.

Descriptors: Slurries, Separation techniques, Aerobic treatment, Dewatering.
Identifiers: Swine, England, Land disposal, Flocculants.

The aim of the research was to convert pig slurry into liquids or solids that were easy and cheap to store and to apply efficiently to land without causing air or water pollution problems. The stages of treatment were: separation to produce a fibrous solid and a free-flowing liquid; treatment by high-rate biological filtration; settlement to produce a wet sludge; gravity filtration of the wet sludge after addition of a flocculant to produce a stackable sludge and a relatively clean filtrate. A continuously-operated pilot plant was developed, all inputs to and outputs from the treatment stages being automatically controlled. Only the separator and surplus filtrate disposal system were manually controlled. For a 6-month period, the plant was fed with 1800 liters of slurry from slatted-floor housing. The plant proved simple to operate, very reliable, and required about 1 man-hour day for servicing and removal of products to store. The filtrate was a straw coloured liquid containing less than 10g-1 $BOD_5$ and 1.5g-1 suspended solids. A mathematical model of the system incorporated into a 500-pig slatted floored fattening house suggested that the quantity of filtrate for disposal to land would be substantially less than for the pilot plant. There were no objectionable smells from the end products. A design for a mechanically-ventilated piggery in which the ventilation and waste treatment systems are integrated has been completed, the objectives being to scrub the exhaust ventilating air and at the same time keep the liquid warm. Apart from removal of the end products, the system will be fully-automatic. (Herpherd-England; Merryman, ed.)

**2640-B2, D3, E1, E3**

## OXIDATION DITCH WASTE MANAGEMENT SYSTEM FOR A LARGE CONFINEMENT SWINE FARM,

Farm owner, Box 26, Lawrence, Kansas 66044
P. Smart, F. McCain, D. L. Day, and B. G. Harmon
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 190-191.

Descriptors: Kansas.
Identifiers: Oxidation ditch, Swine, Evaporation ponds, Slatted floors.

This is a case study of the complete waste management system of the Paul Smart confinement swine farm near Lawrence, Kansas. The intensive confinement enterprise is located on only 24 acres. All feed is brought in pre-prepared from an off-farm commercial feed processing center. At present, the farrow-to-finish enterprise has 150 farrowing stalls producing 15,000 market hogs per year. There are 5 full-time people involved in the husbandry-management of the total enterprise. Oxidation ditches beneath slotted floors have been used since the farm began. Surplus waste materials overflow from the oxidation ditches into evaporation ponds. There is no other waste management used, such as scraping, scooping, hauling, etc. The 11 buildings and 37 rotors are distributed as follows: 3 sow housing—8 rotors; 3 farrowing—3 rotors; 2 nursery—4 rotors; 1 growing—2 rotors; 2 finishing—20 rotors. The rotors, developed under cooperation with Ross E. McKinney of the University of Kansas Civil Engineering Department, are 36 inches wide by 60 inches in diameter and are powered by 5-hp motors. They are performing well with a low level of maintainance problems. The total electricity bill including that for rotors, feeders, and lights has been about $1.00 per hog marketed. The farm management is pleased with the low-odor low-labor method of swine waste management. A method of refeeding aerobically processed wastes is being tested. (Smart, et. al.-Kansas; Merryman, ed.)

**2641-B1,B4,C2,D1,D2,D3, E3,F4**

## RECOVERY OF NUTRIENTS FROM ANIMAL WASTES--AN OVERVIEW OF EXISTING OPTIONS AND POTENTIALS FOR USE IN FEED,

USDA, Beltsville, Maryland
R. G. Yeck, L. W. Smith, and C. C. Calvert
Managing Livestock Waste, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 192-194.

Descriptors: Nutrients, Animal wastes, Feeds, Recycling, Costs, Economics, Constraints, Fermentation, Separation, Dehydration.
Identifiers: Refeeding, Controlled storage.

Processes for the recovery of nutrients from animal wastes can contribute to reduction of solid waste disposal problems, reduction of livestock production and consumer product costs, increase feed supplies and conserve natural resources. The economics of livestock production today provides the greatest immediate incentive for adoption of such processes by livestock producers. Several systems have been researched for recovering nutrients from wastes. A system is composed of resource material, process, and intended use. The resource-animal wastes contain varying quantities of nutrients including protein, energy, phosphorus and other nutrients. Processes include aerobic and anaerobic fermentation, physical separation, dehydration and heat treatment, and controlled storage. Resulting products have been tested in diets of animals for maintenance and various productive functions performance. Several systems are now in successful use. There are constraints to implementation of the various systems. These constraints include animal acceptibility, utility, animal product safety and consumer acceptance. It is anticipated that this review will provide livestock producers information to assist in identifying those systems most applicable to their needs. (Yeck, et. al-USDA)

**2642-B1,C1,C2,C3,D3,E3,F4**

## ENSILING POULTRY FLOOR LITTER AND CAGE LAYER MANURE,

Georgia University, Athens
S. A. Vezey and C. N. Dobbins, Jr.
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, p. 195-196.

Descriptors: Poultry, Litter, Analysis, Waste treatment, Recycling.
Identifiers: Ensiling, Cage layer manure, Lactobacillus acidophilus.

The objective of this project was to develop a method of ensiling cage layer manure as an alternate to drying. The physical characteristics of the raw waste product prohibits mechanical handling by the usual methods of processing ensilage. Exploratory trials using varying mixtures of floor litter, corn, cage layer manure, dried molasses, and *Lactobacillus acidophilus* culture (to accelerate fermentation) were conducted for ensiling and physical characteristics. These trials indicated that the ratio of these ingredients which provided a method for ensiling cage layer manure as a feed for ruminants was: 50 lbs. ground corn, 20 lbs. floor litter, 30 lbs. cage layer manure, 7.5 lbs. dried molasses (absorbed on soybean mill feed), and lbs. *Lactobacillus acidophilus* culture titering $10^{-6}$ to $10^{-8}$, and water q.s. to bring total moisture to 40-45 per cent. The results indicate that the addition of *Lactobacillus acidophilus* and molasses reduced the ensiling time to 4 weeks or less. Analyses for crude fiber, protein, fat, and moisture were replicated on three lots. The data obtained varied less than 0.5 per cent except moisture which ranged from 44.10 per cent to 45.73 per cent. Values for the above were; CF 11.0 per cent, protein 15.56 per cent [1], fat 1.40 per cent. Analyses to delineate mineral and amino acid compositions were also done. Aerobic anaerobic cultures were negative for pathogenic bacteria. Controlled feeding trials have not been conducted, but uncontrolled studies have demonstrated acceptable palatability of the ensilage for ruminants. To make a complete and balanced ration, appropriate vitamin and mineral supplements are necessary. Energy levels can be adjusted by additives to meet desired specifications. (Vezey and Dobbins-Georgia University; Merryman, ed.)

**2643-A11,B2,B3,C1,D1,D3, E3**

## RECYCLING SOLIDS FROM AN AERATED BEEF SLURRY FOR FEED,

Minnesota University, St. Paul
R. O. Hegg, R. E. Larson, J. A. Moore, R. D. Goodrich, and J. C. Meiske
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 197-198.

Descriptors: Aerobic treatment, Slurries, Cattle, Recycling, Feeds, Performance, Energy.
Identifiers: Refeeding, Oxidation ditch, Finishing rations.

Reclaimed solids from an oxidation ditch receiving beef wastes were fed at three rates, 5, 15, and 25 per cent of the ration on a dry matter basis to finishing steers to evaluate this material as a ration component. The 3 reclaimed solids rations plus a high energy control ration were fed to four pens of steers in the 4 month feeding trial. The animals over the oxidation ditch were receiving a ration containing 90 per cent corn plus supplement and were a different group of steers than those on the refeeding study. The conclusions were: (1) The reclaimed solids, collected on a 22 mesh screen, had approximately 50 per cent the feeding value of corn on a dry matter basis. (2) Feed consumption decreased as the percentage of reclaimed solids in the ration increased. (3) The cattle needed a period of several days to adjust to the ration before they would readily consume the animal waste solids. Perhaps some processing of the material would decrease or eliminate this period. (4) The lower energy of the reclaimed solids, would probably make it more suitable in maintenance rations than in finishing rations. (Hegg, et. al.-Minnesota University)

**2644-A11,B2,C2,D3,E3,F5**

## NUTRIENT AVAILABILITY FROM OXIDATION DITCHES,

Department of Animal Science and Department of Agricultural Engineering, respectively, University of Illinois, Urbana.
B. G. Harmon and D. L. Day
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 199-202.

Descriptors: Nutrients, Aerobic treatment, Farm wastes, Proteins, Nitrogen.
Identifiers: Oxidation ditch, Refeeding, State of the art.

This is a state of the art paper that discusses the nutrient content of products of aerobically treated waste and the results of feeding this nutrient source to swine as well as laboratory animals. The paper summarizes publications by the authors and other researchers spanning the past six years. In addition, on-the-farm experiences of swine producers in the midwest United States that have refed the bioenhanced swine waste will be included. The objective of the paper is to discuss the potential and limitations of producing single-cell protein for animal feeding from the contents and in the environment of oxidation ditches and other methods of aerobic treatment. The nitrogen excretory products are incorporated into amino acids and thus become the more important nutrients contributed by the nutrient solution. The oxidation ditch mixed liquor is also rich in minerals and water soluble vitamins. The topics discussed include: (1) Essentiality of maintaining a highly aerobic environment. (2) Amino acid concentration changes occurring in contents of the oxidation ditch. (3) Increase in total nutrient contribution by enhancement of fresh waste to oxidation ditch mixed liquor. (4) Increase with time in ash, the only nonbiodegradable component in the oxidation ditch. (5) Performance of swine fed products of the oxidation ditch. (6) Discussion of practical systems for feeding liquor from the ditches currently in use on swine farms. (7) Discussion of liquids balance demonstrating waste usage by the pigs in excess of liquid available from the oxidation ditch. (8) Potential for establishing a waste treatment system with no overflow. (Harmon and Day-Illinois Univ.)

**2645-A11, B3, C2, C3, E3**

## NUTRITIONAL, PATHOLOGICAL AND PARASITOLOGICAL EFFECTS OF FEEDING FEEDLOT WASTE TOO BEEF CATTLE,

Department of Animal Science, Oklahoma State University, Stillwater
R. R. Johnson, R. Panciera, H. Jordon, and L. R. Shuyler
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 203-205.

Descriptors: Nutrition, Pathology, Parasitism, Performance, Cattle, Feeds.
Identifiers: Dried beef feedlot waste, Refeeding.

Twenty-four beef calves were randomly allotted by weight and sex to 8 pens. Two pens were fed rations containing 85 per cent concentrate plus (1) 15 per cent cottonseed hulls (CSH), (2) 15 per cent dried beef feedlot waste (FLW), (3) 5 per cent CSH+10 per cent FLW or (4) 5 per cent CSH+15 per cent FLW (without protein supplement). Animals were weighed semimonthly. After 91 days on feed, average daily gains in kg. per day were 1.2, 0.7, 1.0 and 0.8 for treatments 1, 2, 3, and 4, respectively. Kg. feed required per kg. gain were 7.2, 11.2, 7.9, and 9.6, respectively. Daily feed consumption at the beginning of the trial was very poor for the groups fed FLW rations but recovered by the end of the trial. Although, FLW did not appear to be a satisfactory substitute for CSH as a roughage source or for the protein supplement, the data were confounded by feed consumption differences. After 91 days on feed, all animals were sacrificed for pathological and parasitological observations. No significant effects due to FLW consumption were observed in the gross or histological pathology of the rumen wall, abdominal wall, intestinal wall, lung, kidney, liver, spleen, trachea, or adrenals. Bile samples from all animals were negative for salmonella. The internal parasite burden (stomach and intestinal worms) was extremely low and not different due to FLW consumption. (Johnson, et. al.-Oklahoma)

## 2646-A11,B3,C1,C2,C3,D1, D2

### MICROBIOLOGICAL AND CHEMICAL ANALYSES OF ANAPHAGE IN A COMPLETE LAYER EXCRETA IN-HOUSE DRYING SYSTEM,

Department of Poultry Science, Michigan State University, East Lansing 48824
T. S. Chang, J. E. Dixon, M. L. Esmay, C. J. Flegal, J. B. Gerrish, et. al.
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 206-207.

Descriptors: Analysis, Microbiology, Moisture content, Chemical properties, Proteins, Calcium, Phosphorus.
Identifiers: Anaphage, Dehydrated cage layer excreta, In-house drying system, Ash, Fiber, Ether extract.

Anaphage (dehydrated cage layer excreta), from a complete in-house drying system, was analyzed microbiologically to determine the microbial population and surviving species. The results indicated that the microbial population was closely related to the moisture content of the anaphage. Only a few species of microorganisms survived the dehydration process. Chemical analyses were also performed on the anaphage from this drying system. Crude protein of the anaphage was measured at 36.59 per cent and corrected protein at 16.41 per cent. The results of the chemical analyses of anaphage on calcium, phosphorus, ash, fiber and ether extract will be reported. (Chang, et. al.-Michigan State University)

## 2647-A11,B1,C1,C2,E3,F1

### NUTRITIONAL PROPERTIES OF FEEDLOT MANURE FRACTIONATED BY CERECO PROCESS,

Department of Animal Sciences, Colorado State University, Fort Collins 80523
G. M. Ward, D. E. Johnson, and E. W. Kienholz
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 208-210

Descriptors: Nutrition, Recycling, Feeds, Feedlots, Cattle, Poultry, Rainbow trout, Performance.
Identifiers: Refeeding, Cereco protein product, Fractionated manure.

Ceres Ecology Corporation has developed equipment which produces three feedlot manure fractions: high fiber silage, dried protein product, and high ash residue. Nutritional studies of the first two products were conducted with cattle and poultry. The Cereco protein product (C-II) was first fed as 0, 5, 10, or 15 per cent of the ration to day-old broiler chicks. Five percent increased gains slightly. Ten and fifteen per cent depressed gains and feed conversion slightly. This C-II contained 21.0 per cent protein but 40.4 per cent ash which diluted the energy density of the ration. In a second trial C-II containing 21.6 per cent protein and 28.6 per cent ash was compared at the 5, 10, or 20 per cent level of the broiler ration. C-II at the 5 or 10 per cent level produced greater weight gains. Equal gains resulted at 20 per cent. A C-II product containing 23 per cent protein and 33 per cent ash was fed as 0, 15, or 30 per cent of the ration for laying hens for six weeks. Both 15 or 30 per cent substitution maintained the same egg production, egg quality, and body weight. The energy value was determined to be 500 kcal of metabolizable energy per kg. The replacement value of C-II in these rations was calculated to be almost $150 per ton. C-II was fed as 14 per cent of the diet of young rainbow trout and gains were essentially the same as the control diet. Older trout received C-II as 14 per cent of diet and had gains of 1 or 2 per cent less than controls. In no case was mortality or morbidity increased. C-II fed to steers resulted in digestibility and nitrogen retention of about 80 per cent of the value obtained with a soybean meal supplement. Cereco silage was fed to 10 Hereford steers to determine digestibility and feed energy value, and compared with corn silage. The composition of Cereco silage and digestibility respectively was dry matter 34.4, 59.3; protein 9.0, 55.5; crude fiber 27.5, 65.3; ether extract 1.8, 90.6, and nitrogen-free extract 50.4, 67.1 per cent. The total digestible nutrient (TDN) content was 60.2 per cent compared to 65.2 per cent for the corn silage used for comparison. The net energy value for maintenance and gain were respectively 1.78 and 1.51 m cal/kg. (Ward, et. al.-Colorado State University; Merryman, ed.)

## 2648-A11, B3, C2, D1, E3

### NUTRITIONAL VALUE OF CATTLE FEEDLOT WASTE FOR GROWING-FINISHING BEEF CATTLE,

Department of Animal Science, Texas Tech University, Lubbock
R. C. Albin and L. B. Sherrod
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 211-213.

Descriptors: Nutrition, Feedlots, Cattle, Southwest U.S., Digestibility, Waste disposal.
Identifiers: Composting, Ground beef feedlot waste, Refeeding.

An attempt was made to determine the nutritive value of feedlot wastes from cattle in the Southwestern United States. Specific objectives were to determine the effect of feeding different levels of beef feedlot waste (FLW) to growing-finishing beef cattle upon acceptability and digestibility; and to determine the effect of the physical form of FLW upon its nutritive value for growing-finishing cattle (composted waste versus dry, ground waste). A one-month collection of FLW was ground through a hammer mill. Rations containing FLW were offered to feeder steers in 3 total collection, digestion trials for 28 days each. Trial I substituted ground FLW at 0, 20, 40 and 60 per cent levels into high-energy finishing ration with adequate protein. Trial II involved composting the FLW, then using similar amounts as in Trial I. Trial III involved the feeding of raw and composted FLW at a 40 per cent level in a low-energy, low-protein ration, resembling a high-roughage growing ration. Each ration was offered to 5 steers. Steers readily consumed rations containing as much as 60 per cent ground FLW, but with a significant linear reduction in ration digestibility. FLW in a low energy-low protein ration significantly decreased ration digestibility. Little difference was observed between raw and composted waste. Nutritional advantage would not be gained by feeding ground FLW to growing-finishing beef cattle, nor would it appreciably improve the waste disposal problem of commercial cattle feedlots. (Albin and Sherrod-Texas Tech; Merryman, ed.)

## 2649-A11, C1, C2, E3

### NUTRITIVE VALUE OF SWINE FECES FOR SWINE,

Department of Animal Science, Virginia Polytechnic Institute and State University, Blacksburg
M. R. Holland, E. T. Kornegay, and J. D. Hedges
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 214-217.

Descriptors: Nutrients.
Identifiers: Refeeding, Swine, Absorbed dry matter, Crude protein, Crude fiber, Ash, Ether extract, Nitrogen free extract.

Twenty-four cross bred gilts weighing about 125 kg were randomly allotted to 3 dietary treatments in an experiment for determining the nutritive value of swine manure fed to swine. Rations containing 0, 24, and 34 per cent (dry basis) were made by substituting fresh manure for equal parts of a 15 per cent corn-soybean meal ration. The rations were fed at either 1.4 or 1.8 kg per gilt per day. The absorbed dry matter (ADMPI), crude protein (ACPPI), crude fiber (ACFPI), ash (AAPI), ether extract (AEEPI), and nitrogen free extract (ANFWPI) as a per cent of intake significantly decreased as manure intake increased. Retained N as a per cent of intake (RNPI) was significantly decreased as manure intake increased; however, retained N as a per cent of absorbed (RNPA) was not significantly decreased. Increased manure intake caused a significant decrease in absorbed (ACaPI) and retained Ca (RCaPI) as a per cent of intake, retained P as a percent of absorbed RPPA, and absorbed K as a per cent of intake AKPI. There were no significant changes in retained CA as a per cent of absorbed (RCaPA), absorbed (APPI) and retained P (RPPI) as a per cent of intake, absorbed Mg as a per cent of intake (RMgPI), retained Mg as a per cent of absorbed (RMgPA), absorbed Cu (CuPI) and absorbed Zn (AZnPI) as a per cent of intake. Based on regression analysis, the extrapolated values of the following criteria for manure were (per cent): ADMPI 52.7, ACPPI 62.9, ACFPI 52.6, AAPI 36.9, AEEPI 63.4, ANFEPI 77.9, RNPI 18.8 and RNPA 31.1 The extrapolated values for the mineral criteria for manure were (per cent) ACaPI 24.8, RCaPI 24.6, RCaPA 99.3, APPI 31.0, RPPI 29.8, RPPA 95.8, AMgPI 25.0, RMgPI 24.6, RMgPA 96.1, ACuPI 15.2, AKPI 70.9 and AZnPI 20.5. Substitution of a basal corn soybean meal ration with fresh swine manure decreased the quality of the ration. (Holland, et. al.-Virginia; Merryman, ed.)

## 2650-A11, B1, B3, C2, E3

### THE INCLUSION OF PIG MANURE IN RUMINANT DIETS,

School of Agriculture and Forestry, Melbourne University, Parkville, Victoria, Australia
G. R. Pearce
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 218-219.

Descriptors: Diets, Cattle, Chemical properties.
Identifiers: Refeeding, Swine, Dried pig manure, Australia, Digestibility, Nitrogen retention, Copper balance.

The potential for recycling livestock waste with respect to Australian conditions are discussed briefly. In many areas the economic disposal of wastes from intensive piggeries poses the greatest problem. The results of experiments conducted by the University of Melbourne, Victoria, using pig manure are described: (1) The composition of pig manure from different sources (including contents of a number of mineral elements). (2) The utilization of dried pig manure by cattle when fed at 0, 15, 30 and 45 per cent of the diet (digestibility, nitrogen retention, copper balance). (3) Some effects of feeding dried pig manure, at 30 per cent of the diet, continuously to cattle over a period of about 8 weeks. (4) The utilization of dried pig manure by sheep when fed at 0, 15 and 30 per cent of the diet; attempts to prevent copper toxicity by additions of molybdenum. (Pearce-Melbourne University)

## 2651-A11, E3

### A SUMMARY OF REFEEDING OF POULTRY ANAPHAGE, MORTALLITY, RECYCLING HENS, AND EGG PRODUCTION,

Department of Poultry Science, Michigan State University, East Lansing 48824
C. J. Flegal, H. C. Zindel, C. C. Sheppard, T. S. Chang, et. al.
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 220-221.

Descriptors: Mortality, Recycling, Dehydration, Health, Diseases.
Identifiers: Refeeding, Poultry anaphage, Egg production, Waste management, Marek's Disease, Lymphoid Leukosis.

The Environmental Protection Agency project at Michigan State University, entitled "Demonstration of the Handling, Dehydrating, and Utilization of Poultry Excreta" involved the purchase of 5000 twenty-week old, ready-to-lay, pullets. The birds came into production at the normal rate but soon displayed symptoms of several diseases, including Marek's and Lymphoid Leukosis. Inasmuch as production of excreta was the key criteria, normal egg production was assumed to be satisfactory. However, as the project progressed, the death loss mounted and health treatments as recommended by personnel of the College of Veterinary Medicine had no effect. Additional birds were bought to bring the population back to 5000 birds but these additions had little or no effect on production figures. Recycling birds (molting) had no positive effect on egg production. Fecal production continued at a normal rate. Poultry anaphage was fed to one-half the bird population at the rate of 10 per cent. (Flegal-Michigan State University)

## 2652-A11, C3, D3, E3

### ENSILING BROILER LITTER WITH CORN FORAGE, CORN GRAIN AND WATER,

Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
J. P. Fontenot, L. F. Caswell, B. W. Harmon, and K. E. Webb, Jr.
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 222-226

Descriptors: Poultry, Litters, Feeds, Bacteria, Coliforms, Fermentation.
Identifiers: Ensiling, Refeeding.

Ensiling is a potentially valuable processing method for destruction of pathogens in animal waste. Experiments were conducted to study the feasibility of ensiling broiler litter with corn forage, high-moisture corn grain and added water. All ensiling was in sealed polyethylene bags. Broiler litter was ensiled with corn forage harvested when it contained 30-40 per cent dry matter. The levels of litter were 0, 15, 30 and 45 per cent dry basis in small laboratory silos (2 kg) snf 0, 15 and 30 per cent in larger silos. Small silo silages were studied for fermentation characteristics. Large silo silages were studied for metabolism and palatability as well. All mixtures preserved well and showed favorable fermentation characteristics. High levels of broiler litter increased total bacteria in silage, though coliforms were lower. Addition of litter increased crude protein in silages. Silage pH varied from 3.6 to 4.7 and tended to be higher in silages containing broiler litter. Apparent digestibility of crude protein was increased by addition of litter to corn forage. Nitrogen retention was greater for sheep fed silages containing broiler litter, indicating that the litter nitrogen was utilized. Addition of litter to corn forage increased dry matter intake by ruminants. (Fontenot, et. al.-Virginia Polytechnic Institute and State University; Merryman, ed.)

## 2653-A11, B1, D1, E3

### CONVERSION OF ANIMAL WASTES TO FEED SUPPLEMENTS VIA THE ORGANIFORM PROCESS.

Orgonics, Inc., Slatersville, Rhode Island
C. K. Davies, G. A. Varga, and R. S. Hinkson
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 227-229.

Descriptors: Organic wastes, Fertilizers, Feeds, Cattle, Performance, Research and development.
Identifiers: Refeeding, Organiform.

Since the Organiform process is already being successfully applied commercially, its application to the animal waste problem and other organic wastes is timely and does not require massive research and development to meet the EPA feedlot waste deadlines. Organiform, a process developed by Orgonics, Inc. of Slaterville, Rhode Island, is a trade name given to a series of products resulting from reaction of and the proteinaceous constituents of many organic wastes. The Organiform process is based on the reaction of urea and formaldehyde to form methylol ureas. These highly biocidal compounds effect sterilization of Organic waste and after addition of a catalyst, a methylenization reaction brings about conversion of the waste material to an entirely new entity, which is sterile, stable, and in most cases, odorless. Since the resulting Organiform products showed such excellent fertilizer properties, and the chemical nature of the products were well assimilated by soil bacteria, the Organiform process seemed applicable to cattle manure, and the resulting product (Organiform CM) was evaluated as a high nitrogen feed supplement. The cattle manure was processed in the form of a slurry and resulting Organiform CM was added to ground corn and dried to form a pre-mix which was incorporated into a total diet. Preliminary data obtained with dairy heifers and two rumen-fistulated Holstein steers indicate that feed containing Organiform CM, at a level to provide 31 per cent of the crude protein, was readily acceptable and palatable. All animals made respectable body weight gains. (Davies, et. al.-Rhode Island; Merryman, ed.)

## 2654-A11,B3,B5,C3,D3,E3.

### HEALTH ASPECTS OF FEEDING ANIMAL WASTE CONSERVED IN SILAGE,

Department of Animal and Dairy Sciences, Auburn University, Auburn, Alabama
T. A. McCaskey and W. B. Anthony
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 230-233.

Descriptors: Performance, Salmonella, Silage, Coliforms.
Identifiers: Refeeding, Health, Cattle manure, Ensiling.

Animal waste harvested from the feeding floor of confined reared cattle has been blended with various feed ingredients and stored as silage prior to feeding. Extensive tests show that common feed ingredients containing sufficient carbohydrates to support an acid microbial fermentation can be blended with manure to make an effective animal feed. A balanced complete feed mixture (basal) was blended 1.5:1 with wet animal waste, stored in a silo, and fed to yearling cattle to produce the same rate of animal performance as obtained when the basal ration was fed alone. In all tests, animal waste had appreciable feed replacement value. A study was conducted with 27 Salmonella cultures inoculated ($66x\ 10^6$ cells/g) into manure-containing feed and into the manure used to prepare the feed. None of the cultures were recovered from the feed mixture after 3-day ensiling at 25 degrees C; whereas, 25 of the Salmonellae cultures were recovered from the inoculated manure under similar conditions. Manure with a pH of 6.0 to 6.5 prior to inoculation permitted 25 cultures to survive 3 days; whereas, no cultures survived in manure with an initial pH of 4.0 to 4.5 The ensiling temperature had a pronounced effect on Salmonellae survival. With an improved recovery technique, 21 of the 27 Salmonellae were recovered from feed ensiled 4 days at 5 degrees C, 25 from feed ensiled at 15 degrees C, one at 25 degrees C, and none at 35 degrees C. The pH of the feed ensiled at 25 degrees or 35 degrees was lower than for ensiled feed held at 5 degrees or 15 degrees C. The coliform count decreased from approximately $1 \times 10^6$/g at 5 degrees C. (McCaskey and Anthony-Auburn University; Merryman, ed.)

## 2655-A1, B1, D3. E3. F1

### START-UP OF PILOT SCALE SWINE MANURE DIGESTERS FOR METHANE PRODUCTION,

Professor, Department of Agricultural Engineering, University of Manitoba, Winnipeg, Manitoba, Canada
H. M. Lapp, D. D. Schulte, E. J. Kroeker, A. B. Sparling, and B. H. Topnik
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 234-237.

Descriptors: Research and development, Canada, Methane, Anaerobic treatment, Design criteria, Economics.
Identifiers: Swine, Environmental impact.

A three-phase program including bench-scale studies, pilot plant operation and full farm scale anaerobic treatment of swine waste was initiated in 1971 to evaluate the technical and economic feasibility of the process in Manitoba, particularly during cold winter temperatures. Specific objectives of the project were to: (1) complete a preliminary evaluation of the economics of anaerobic digestion as a process for recovering energy from livestock wastes; (2) determine the design parameters for methane gas production from animal wastes in cold climate regions representative of Manitoba and Canada; (3) develop simple, safe and economical methods of collecting, purifying, storing and utilizing methane on livestock farms; (4) analyze the effluent and assess its value as a fertilizer and (5) assess the environmental impact, if any, of the anaerobic digestion process. Results of bench-scale, initial and recent winter operation of the pilot plant are discussed in relation to project objectives. Problems associated with purification, handling, and storage of methane together with experience gained in the operation of a one-half ton pick-up truck equipped to operate on methane are outlined. (Lapp, et. al.-Canada; Merryman, ed.)

## 2656-B1, D3, E3, F1

### SMALL METHANE GENERATOR FOR WASTE DISPOSAL,

Specialist, Joint Commission on Rural Reconstruction, Taipei, Taiwan
C. Po, H. H. Wang, S. K. Chen, C. M. Hung, and C. I. Chang
Managing Livestock Wastes, Proceedings 3rd Inter-

national Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 238-240.

Descriptors: Methane, Recycling, Design, Fertilizers, Energy.
Identifiers: Swine, Taiwan, Construction materials.

Taiwan produces 6 million pigs a year, most of which are kept in small "family" units, and frequently "Manure Credit" is the only profit in pig raising. In the traditional way of compost making, much of the nitrogen is lost in the form of ammonia. In an effort to improve the fertilizing value of the manure and, at the same time, to produce some fuel gas therefrom, small simple methane generators costing $300 each have been developed and widely extended in Taiwan. The generator consists of an excavated brick digester of 5' x 5' x 6' and an inverted steel gas holder of 6' x 6' x 3' resting in the water seal. The digester is connected to the pigsty by a cement pipe through which the wastes and sewage of 10-15 hogs are fed daily, and the production of gas is continuous. The gas contains 63-67 per cent $CH_4$, 27-33 per cent $CO_2$ and 1.7 per cent $H_2S$. The hydraulic retention time is estimated at 5-10 days. Under the subtropical conditions, the gas produced is about 3,000 liters a day, which is enough for cooking three meals for a family. When used for the generation of electrical power, the gas is enough to run a 4-HP Kohler engine for operating a 2-KW generator for 3 hours a day. Experiments are underway to find alternative construction materials, such as rubber bag, PVC-impregnated mud plate and fiber glass gas holder to lower the cost so that the digesters can be commercialized. Oxidation ditches are also built beside the digester for further disposal of swine wastes. (Po-Taiwan)

2657-B1, C2, D2, E3, F1

### PRODUCT APPLICATIONS OF TREATED LIVESTOCK WASTE,

Materials Department, School of Engineering and Applied Science, California University, Los Angeles
C. Corvino, B. Dunn, E. Tseng, and J. D. Mackenzie
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 241-243.

Descriptors: Recycling, Pigments, Feedlots, Cattle.
Identifiers: Pyrolysis, Swine, Carbon content, Filler, Building materials.

Cattle and hog manures have been pyrolyzed at fairly low temperatures yielding solid and gaseous byproducts. The volatile fraction is condensed in two stages. An aqueous portion is collected at lower temperatures (100 degrees C or so). The nitrogen-rich liquid holds promise as a fertilizer. At greater temperatures, a low sulfur crude oil is condensed for cattle manure. The sulfur and nitrogen contents are fairly low. Chemical analyses of these liquids are presented for manure samples of different feedlots. Uncondensed vapors are combustible. Hog manure yields a wax-like product rather than oil. The pyrolyzed product is a black carbonaceous aluminosilicate solid. The material has been successfully substituted for carbon black in such products as printing ink, paint and rubber where the treated manure serves as a pigment and filler. The properties of these materials are described. The carbon content is controllable from temperature and rate of pyrolysis. One very promising application of the pyrolyzed solid is in combination with glass. High quality tiles have been made whose properties, in many cases, are superior to currently marketed products. The fabrication process and resulting properties are presented. Economic analyses for the production of treated manure and the manufacture of certain products are given. (Corvino, et. al.-California University; Merryman, ed.)

2658-B1,B5,C1,C2,C3,D3,E3

### CHARACTERIZATION OF METHANE PRODUCTION FROM POULTRY MANURE,

Department of Microbiology, Maine University, Orono
H. M. Hassan, D. A. Belyea, and A. E. Hassan
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 224-247.

Descriptors: Methane, Anaerobic digestion, Energy, Feed, Poultry.

Laboratory scale digesters of different sizes were designed to study the optimum conditions and the kinetics for methane production. Fresh manure (28-35 per cent solids) from caged layers was used. The results indicated that solids content of 6.5-6.75 per cent provided the highest gas production, and the methane content reached 87 per cent for a retention period of 30 days. 130 liters of methane per kilogram of dry manure solids were produced at 6.74 per cent solids concentration. A relationship between sludge solid content and retention period was established. 50-70 per cent reduction in solids contents of the completely digested effluents was achieved. The presence of exogenous carbon (2-8 per cent) in general increased the total production of methane gas. The rate of gas production was to the size of inoculum used. The volatile acid content of the effluent increased, then declined as the percentage of methane in the evolved gas reached maximum. The gas produced contained 6 PPM hydrogen sulfide, sufficient to give a distinct odor. The methanogenic bacteria predominately presented in the system were Methanobacterium sohngenii and Methanobacterium omelianskii. A 600 gallon demonstration unit was designed and operated on a batch basis, using the results of the laboratory scale digesters, in order to test the control and feed mechanisms for a future full scale system application. The daily gas production from the 500 gallon sludge increased from 8 ft after mixing to 40 $ft^3$ with the gas methane content approaching 82 per cent, then declined indicating that partial recharging with predigested manure was required. (Hassan, et. al.-California University; Merryman, ed.)

2659-C2,D2,D3,E3,F1,F6

### SEPARATING NUTRIENTS TO ENHANCE SWINE-WASTE DIGESTION,

Associate Professor of Civil Engineering, Department of Civil Engineering, Kansas State University, Manhattan
L. A. Schmid, R. I. Lipper, J. K. Koelliker, C. A. Cate, and J. W. Daber
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 248-251.

Descriptors: Anaerobic digestion, Methane, Fertilizers.
Identifiers: Swine, Nutrient separation, Ammonium phosphate.

Total confined feeding of livestock results in the capture of all wastes, urine, and feces, resulting in a very high nitrogen waste. Anaerobic digestion and biological stabilization is often hampered due to toxicity caused by ammonium buildup. This has resulted in the need to add dilution water, increasing the waste volume and consequently the disposal costs. This project was designed to explore a novel method of waste treatment that would reduce the toxic ammonium, increase waste stabilization and methane gas production, eliminate need for dilution water, reduce volume for ultimate disposal to land and produce a clean liquid ammonium phosphate fertilizer. The test facility consists of an eight foot cubed anaerobic digester serving 120 swine. Sealed gas blowers collect the gas from the digester and pass it through a phosphoric acid column for removal of ammonia and conversion to ammonium phosphate. It then passes through a potassium hydroxide column for removal of carbon dioxide. The cleaned methane gas is recycled to the digester for further mixing and gas stripping with the excess clean gas burned and used for digester heating. Carbon dioxide must be removed to maintain the digester equilibrium pH near 8. Because of digester detention times of 15 to 20 days ammonia can be reduced at these pH values. Gas recirculation rate is approximately 50 cfm. per 1000 cu. ft. of digester volume. Design and operational recommendations, with seven months of field data, are presented along with the proposed economics of a large scale system. (Schmid, et. al.-Kansas State University)

2660-A8, C2, E2

### RESIDUAL AND ANNUAL RATE EFFECTS OF MANURE ON GRAIN SORGHUM YIELDS

Soil Scientist, USDA Southwestern Great Plains Research Center, Bushland, Texas 79012
A. C. Mathers, B. A. Stewart, and J. D. Thomas
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 252-254.

Descriptors: Fertilizers, Crop response, Grain sorghum, Feedlots, Nitrates, Salts, Soil profiles.
Identifiers: Land disposal, Application rates.

The effect of varying rates of feedlot manure on irrigated grain sorghum (Sorghum bicolor) production has been studied for 5 years. The treatments were 0, 22, 67, 134, and 268 tons per hectare (T/ha wet weight, approximately 50 per cent water) applied annually. Other treatments were 538 T/ha applied the initial year only and 538 t/ha for the initial three years. Commercial fertilizer plots were also included for comparison. All treatments were replicated three times in level borders and irrigated equally as necessary to support good crop growth. Soil analyses were made at seeding time to determine the soil salinity and nitrate, nitrite, and ammonium contents of the seed-zone. Following harvest, soil samples were taken to 6 meters to determine the concentration and distribution of nitrate and total salts in the profile. Grain yields were similar for plots receiving 22, 67, and 134 T/ha of manure annually. The check treatment yielded less because of nitrogen deficiency and the plots receiving 268 and 538 T/ha yielded substantially less because of high concentrations of salts, ammonium, and nitrite in the soil at seeding time. The detrimental effects of these compounds decreased with time, rainfall, and continued irrigation. The productivity of plots receiving 568 T/ha manure was fully recovered within two years after the applications were stopped. Soil on plots receiving 67 T/ha or more manure annually contained excess nitrate. Some of this nitrate moved as deep as six meters with the irrigation water. However, most of the nitrate accumulated in the top two meters of soil. Manure applied at 22 T/ha was adequate to produce near maximum yields of grain sorghum without causing appreciable accumulations of nitrate or salt in the soil. Where large amounts of manure were applied, concentrations of salts and ammonium decreased within two years to levels that were no longer detrimental to the production or irrigated grain sorghum. (Mathers-USDA)

2661-A2, B2, E2

### DIRECT LAND DISPOSAL OF FEEDLOT RUNOFF,

U.S. Department of Agriculture, Agricultural Research Service, University of Nebraska, Agricultural Engineering Building, Lincoln, Nebraska 68503
N. P. Swanson, C. L. Linderman, and L. N. Mielke
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 255-257.

Descriptors: Agricultural runoff, Nutrients, Irrigation, Design.
Identifiers: Land disposal, Field sink, Serpentine waterway.

Land disposal of collected feedlot runoff permits utilization of nutrients and of the water as irrigation. Runoff supplies, however, are not dependable, and facilities and equipment for storage and irrigation distribution require a minimum investment and periodic management irrespective of the size of the feedlot enterprise. Distant overland flow of feedlot runoff, under natural topographic conditions, prior to ultimate discharge into a stream has been judged not to be an environmental hazard in many states. Many feeders would prefer to assume some soil and crop management problems for direct disposal of runoff in lieu of storage and later distribution. This alternative is possible with the use of a field sink on a reasonably level disposal area or a serpentine waterway on a sloping site. Both are described in detail. Direct application on the land can save both investment and time for the many feeders with smaller facilities, and provide adequate protection for the environment. (Swanson-USDA; Merryman, ed.)

## 2662-A3,A8,A11,B5,C2,E2

### LAND DISPOSAL OF BEEF WASTES: CLIMATE, RATES, SALINITY, AND SOIL

South Dakota State University, Brookings, South Dakota 57006
M. L. Horton, J. L. Halbeisen, J. L. Wiersma, A. C. Dittman, and R. M. Luther
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 258-260.

Descriptors: Cattle, Crop response, Nutrients, Salinity, Performance, Agricultural runoff, Leaching, Soils.
Identifiers: Land disposal, Northern Great Plains, Management guidelines.

Disposal of wastes in cold regions with insufficient rainfall for leaching presents some unique problems in waste management. The purpose of this study was to develop management guidelines for the disposal of beef wastes on the land in the Northern Great Plains. The region is characterized by soils with a generally high clay content and a high natural salinity. With generally insufficient leaching water available from natural rainfall, the nutrients and salts added in the wastes accumulate and affect crop growth. The objectives were (1) to evaluate the influence of salt level in the ration upon the wastes produced, (2) to determine the maximum waste application rate for land subsequently cropped and (3) to determine the accumulation and redistribution of waste components applied to the soil. Much of the salt added in the ration is excreted and appears in the manure. The dispersing characteristic of sodium affects waste properties and may be detrimental to soils which already have considerable quantities of sodium present in the profile. Beef wastes were applied to field plots at rates approximating 0, 20, 40, 60, and 80 tons of dry matter per acre. Applications were completed in May, 1974, and corn was planted for silage shortly after field application. The 80 ton per acre rate generally caused poor corn growth. However, for similar application rates, the wastes produced by animals receiving a higher added salt level gave an added detrimental effect on corn growth. Results will be reported for waste characteristics, first year crop yields and animal performance. Results are preliminary for soil effects, runoff and leaching. (Horton-South Dakota State University)

## 2663-A2,B2,B3,E2,F1,F6

### DISPOSAL OF BEEF FEEDLOT WASTES ONTO LAND,

Department of Agricultural Engineering, Kansas State University, Manhattan
H. L. Manges, R. V. Lipper, L. S. Murphy, and W. L. Powers
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 261-263.

Descriptors: Feedlots, Cattle, Kansas, Crop response, Salts, Nitrogen, Equations, Agricultural runoff.
Identifiers: Land disposal, Application rates, Soil cores.

The objectives of the reported research were to determine the optimum feedlot waste application rates onto land with a minimum of pollution to land and the ground water. The research was conducted in cooperation with the Pratt Feedlot, Inc., a 35,000 head commercial feedlot in Southcentral Kansas. Feedlot runoff and feedlot manure were spread onto different land areas at varying application rates for five years. Corn was grown on the waste disposal area. The corn was furrow irrigated from a well as needed for high corn yields. Feedlot runoff application rates were determined from inflow-outflow measurements in the irrigated furrows. Feedlot manure application rates were determined from the weight of manure caught on strips of plastic during spreading. Corn forage yields were measured by weighing forage mechanically harvested from test rows. Soil cores were taken annually and analyzed to determine changes in chemical composition. Highest corn forage yields were obtained at waste application rates in excess of those necessary to supply the recommended nitrogen fertilization rates. However, there was a buildup of salts and nitrogen in the soil. At waste application rates necessary to supply the recommended nitrogen fertilization, corn forage yields were near maximum and salt and nitrogen buildup in the soil were not significant. Corn forage yield prediction equations have been developed from yield data from the waste disposal studies. These equations will be used in determining the most economical waste application rate, both feedlot runoff and manure. (Manges-Kansas State University)

## 2664-A8,A11,B3,C2,C3,E2

### LONG-TERM BROILER LITTER FERTILIZATION OF TALL FESCUE PASTURES AND HEALTH AND PERFORMANCE OF BEEF COWS,

USDA, ARS, Watkinsville, Georgia
J. A. Stuedemann, S. R. Wilkinson, D. J. Williams, H. Ciordia, J. V. Ernst, W. A. Jackson, and J. B. Jones, Jr.
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 264-268.

Descriptors: Litters, Fertilizers, Crop response, Health, Performance, Cattle, Fescues.
Identifiers: Grass tetany, Land disposal, Application rates.

Abundance of poultry litter in some areas of the Southeast has resulted in heavy rates of pasture fertilization with poultry litter. Heavy fertilization of tall fescue pastures may be accompanied by an increased incidence of grass tetany and hard fat deposits. An experiment was performed to determine the long-term effects of heavy broiler litter fertilization of Kentucky-31 tall fescue pastures on beef cow health and performance. Three fescue pasture systems receiving three different application rates were utilized. Mean cow weight patterns and the quantities of available forage were directly related to the level of N fertilization. However, there were little differences in adjusted 205-day weaning weights. Conception rates were generally acceptable on all pastures. The occurrence of fat necrosis was related to the level of N fertilization. No appreciable differences in strongyle eggs and coccidia oocysts were observed among cows grazing pastures at the three levels of fertilization. Broiler litter fertilization resulted in elevated nitrate in soil and herbage, increased arsenic content of cow hair, a trend toward lower grass and blood serum Se levels, and greatly increased size and numbers of earthworms. Intermittent analyses of pond water derived from runoff from the broiler littered pasture indicated a maximum $NO_3$-N content of 5.0 ppm. Soil analyses indicated a maximum $NO_3$-N contents in excess of 10 ppm beneath the fescue root zone. Broiler litter fertilization of fescue pastures appears acceptable from animal health and performance, and environmental quality points of view if no more than 9 metric tons/ha/year are applied. However, at this rate grass tetany prevention techniques will be required as well as good pasture management to utilize the herbage produced. (Stuedemann-USDA; Merryman, ed.)

## 2665-A3, A8, C2, F2

### MANURE FROM CAGED HENS EVALUATED ON FESCUE PASTURE,

Poultry Department, Bldg. T-14, University of Missouri, Columbia 65201
J. M. Vandepopuliere, C. J. Johannsen, and H. N. Wheaton
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 269-270.

Descriptors: Poultry, Fescues, Crop response, Agricultural runoff.
Identifiers: Land disposal.

This study was conducted to determine the maximum level of cage hen manure that can be applied to fescue pastures without injuring the plants or creating detrimental effects from runoff. Six replicated field test plots at the UMC poultry farm were used along with test plots on three commercial poultry farms. The manure applied on the UMC plots (6'x12') was weighed and spread manually. Manure was applied by flail spreaders or a honey wagon. Levels of 10, 20, 30 and 40 T/A were applied in February, 1973. A control plot with no added nutrients and a plot receiving commercial fertilizer supplying approximately the amount of nitrogen equivalent to the nitrogen provided with the use of 10T manure/A was included. Small sheets of plastic and shallow containers were used to measure the quantity of manure applied to each field plot. Strips, 10 feet long, were harvested and dried on May 9, August 1, and October 15, 1973. Strip width was measured and the area mowed was used to calculate the harvest yield. Fescue yields increased as the level of manure applied increased from 0-20T/A on the three farm locations. Levels above 20T/A produced a small additional response when the flail spreader was used; however, the yield was reduced slightly with honey wagon use. The carry-over effect on forage yield during the second year appeared to be minimal. Fescue yields on 6-20-74 at the UMC poultry farm were 2.94, 3.19 and 3.24 (T/A) for 0, 10 and 40T/A respectively. Assays of soil samples demonstrated an increase in P, K, and Ca. Analytical values of fescue harvested May 9, 1973 showed increases in plant tissue levels of N, P, K, Na, Ca, Mg, Cu, Fe, Zn, Mn, Al, B, and Mo when the 40 T/A was compared with the control. These data suggest that cage hen manure should be spread thinly. The maximum level should not exceed 20 T/A. Surface loss due to runoff was minimal. (Vandepopuliere-Missouri University; Merryman, ed.)

## 2666-A8, C2, C3, E2

### THE EFFICIENCY OF USING SLUDGE FROM PIG GROWING COMPLEXES AS ORGANIC FERTILIZER,

Research Investigation Department, Land Reclamation, Research Institute, Spl. Independentei 294, Bucharest V11-17, Romania
Vl. Ionescu-Sisesti, I. Jinga, Gh. Roman, and Gh. Pricop

Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 271-273.

Descriptors: Sludge, Fertilizers, Crop response, Fermentation, Pathogens.
Identifiers: Swine, Land application, Application rates.

The experimental results obtained from the utilization as organic fertilizer of the sludge resulting from the purification of the used waters in the industrial pig-growing complexes are presented. The studies have been carried out on a slightly levigated chernosem, well supplied in humus and on an alluvial carbonatic soil medium supplied in humus. It has been found that the sludge can be used as an organic fertilizer like the farmyard manure in all the field crops tested (lucerne, sugar beet, fodder beet, corn, soybeans, sunflower, fibre hemp, potato) and that high and profitable yields can be obtained. The suggested rate is 13-20 t/ha with grain corn and 30 t/ha with fodder beet without chemical fertilizer addition. Since the contamination effect with pathogenous agents on the surroundings has not been followed, the utilization of sludge as an organic fertilizer can only be admitted when no pathogenous agents have been signalled or after disinfection during the fermentation process. (Sisesti-Romania)

## 2667-A8, B2, C1, D3, E2

### THE YIELD RESPONSE OF GRASS TO AEROBICALLY STABILIZED SWINE WASTE,

Bacteriology Division, School of Agriculture, 581 King Street, Aberdeen, Scotland
S. M. Mutlak, A. D. McKelvie, K. Robinson
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 274-276.

Descriptors: Crop response, Slurries, Grasses.
Identifiers: Swine, Land disposal, Application rates, Yields, Composition.

Laboratory and field studies were conducted to determine the effect of aerobically stabilized waste on crops and soil. Comparison was made to a field experiment concerning the effect of rates of waste application on grass growth. Aerobically stabilized slurry, adjusted to contain 8 per cent suspended solids, was applied to $1m^2$ plots in an established perennial ryegrass-clover pasture at rates varying from 12-50$m^3$/ha/14 days. In addition the same rates of suspended solids or liquid of the slurry were applied alone to plots and the results obtained compared with two rates of application of the supernatant liquor from an anaerobic lagoon. The yield and composition of grass were determined at monthly intervals during a three-month period. Statistical analysis of the results revealed that although application of aerobically stabilized waste generally produced a significant increase in yield, the effect of the separate and combined fractions was different varying from zero for the suspended solids to 31 per cent increase for liquid alone. Yield increase for the anaerobic supernatant treated plots was 64 per cent. No clear trend was observed for increased rate of application of aerobically stabilized waste but an increase occurred with anaerobic supernatant. It seemed that the liquid and suspended solids alone and the anaerobic supernatant had a harmful effect. Changes in chemical composition of the grass can be illustrated by nitrogen composition and did not necessarily follow the same pattern as for yield. For example solids alone had no effect. Liquid alone increased the yield and the slurry gave higher nitrogen than its separated components. The anaerobic supernatant gave the highest nitrogen content and it would appear that there is a relationship between the state of the nitrogen applied and its uptake by the plant. (Mutlak-Scotland; Merryman, ed.)

## 2668-A8, B2, C2, E2, F2

### A PRACTICAL MANAGEMENT SYSTEM FOR POLLUTION-FREE LAND SPREADING OF ANIMAL WASTES,

Department of Agricultural Engineering, Newcastle University, England
K. A. Pollock and J. R. O'Callaghan
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 277-281.

Descriptors: Slurries, Nutrients, Legal aspects.
Identifiers: Land spreading, Great Britain, Guidelines.

Trials were conducted to examine the practicability of principles of slurry management published in previous reports of work at Newcastle. They were intended to assess the accuracy of the principles, and their ease of application by farmers and advisors. Hydraulic loading capacity of the soil was estimated from the cumulative soil moisture deficit, which may be reduced by slurry application without causing water pollution. Chemical loading capacity was determined by the crop fertilizer requirements in a season, which may be supplied in the slurry without leaching or accumulation. Under British conditions, the two capacities are of a similar order for some crops to which slurry is applied so that the two criteria may interact under the unique conditions of the farm under consideration. A two-year field trial on two widely separated commercial farms was carried out, with a third site being established later on the University Experimental Farm. In each case, long term planning decisions were possible based on an examination of historical weather data and cropping policies. Day to day management was assisted by calculation of soil meisture deficit using actual rainfall values. Results generally confirmed the spreading principles, there being minimal and short-lived water pollution, and good recovery of most nutrients. Some crop damage was experienced, and under high application rates, near-toxic levels of $NO_3$-N and K were found. Further detailed work is needed on recovery of slurry nutrients by different crops. Preliminary conclusions are that, if the information required was made available to advisors and farmers in an appropriate form, long and short term decisions concerning slurry utilization could be facilitated. (Pollock-England; Merryman, ed.)

## 2669-B1,B4,C2,D3,E2,F4

### NUTRIENT LOSSES FROM LIVESTOCK WASTE DURING STORAGE, TREATMENT, AND HANDLING,

Agricultural Engineering Department, University of Illinois, Urbana-Champaign
D. H. Vanderholm
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 282-285.

Identifiers: Nutrient losses, Literature review, Land disposal.

This paper is a review of literature containing data on nutrient losses. This literature review was initiated as a basis for an extension publication on planning land disposal systems and for a section on waste utilization to be included in the Midwest Plan Service Livestock Waste Handbook currently under preparation. In many situations, especially in planning operations, estimates of the quantity and nutrient content of excreted wastes are readily available, but characteristics of the wastes after storage, treatment, and handling are difficult to obtain. Estimates of the nutrient content of the wastes at this stage can be made if losses can be predicted. This literature review contains information on the magnitude of the losses to be expected as well as on the loss mechanisms involved. Examples of the types of losses discussed are ammonia volatilization from feedlot surfaces, ammonia losses during pit storage and spreading operations, denitrification at or near the soil surface, and phosphate precipitation in anaerobic lagoons. The data is presented in summarized form for reference purposes and examples are presented for estimating total nutrient losses on a system basis. (Vanderholm-University of Illinois; Merryman, ed.)

## 2670-A5, B2, C2, C3, E3

### DAIRY LAGOON SYSTEM AND GROUNDWATER QUALITY,

Agricultural Engineering Department, University of Tennessee, Knoxville
J. I. Sewell, J. A. Mullins, and H. O. Vaigneur
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 286-288.

Descriptors: Lagoons, Dairy industry, Tennessee, Sampling, Seepage, Coliforms, Streptococcus, Chloride, Nitrates.
Identifiers: Groundwater quality.

In June, 1973, a manure lagoon and holding pond were constructed for a new 125-cow dairy at the West Tennessee Experiment Station. Research was instigated for determining lagoon seepage rates and the effects of lagoon operation on shallow groundwater quality. The lagoon was constructed in a terrace formation of fine sandy loam of low permeability to a depth of about 6 feet and sands with high permeability at depths from 6-20 feet. The normal water table depth varies from 8-20 feet and has a moderate gradient toward a bottom land. Seven test wells located near the lagoon and holding pond and extending into the groundwater table were installed in June, 1973. From that date until lagoon startup in April, 1974, background levels of groundwater quality parameters were evaluated monthly. At startup, lagoon seepage was about one foot per week with full lagoon. A water balance is being maintained by daily recording the operation of four flush tanks of known volumes. By August, 1974, lagoon seepage had decreased markedly. To date, water-table levels have shown little change due to system operation. Weekly determinations of fecal coliform, fecal streptococci, chloride, and nitrate nitrogen are made for each well. Nitrate-nitrogen and chloride levels have shown little change. However, fecal coliform and streptococci have, in the wells near the holding pond where the groundwater table is about 8 feet below the ground surface, tended to increase. Analysis of available data suggests that the lagoon system operation may have little effect on chemical levels but may increase bacterial concentrations on the downslope side. A system for recirculating lagoon effluent from the holding pond for flushing alleys is under construction. Quality parameters will be determined for the recirculated flush water. (Sewell, et. al.-University of Tennessee; Merryman, ed.)

## 2671-A2,A5,A8,B2,B4,C2, E1

### SEEPAGE BENEATH FEEDYARD RUNOFF CATCHMENTS,

USDA Southwestern Great Plains Research Center, Bushland, Texas
R. N. Clark
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 289-290.

Descriptors: Feedlots, Agricultural runoff, Groundwater pollution, Texas, Seepage, Nitrates, Nitrites, Chloride, Soil water.
Identifiers: Catchments, Playas, Soil sealing treatments, Clay liner, Incorporated bentonite.

Recent laws require collection and storage of all feedyard runoff for control of surface water pollution;

however, seepage from these catchments offer a potential for ground water pollution. Research studies were begun in 1969 at Bushland, Texas, to evaluate the seepage and sealing effects of impounded feedyard runoff. This paper presents results from two types of runoff catchments, one naturally occurring and one man-made. Some feedlots in the area are located near shallow, saucer-type natural lakes called "playas," while holding ponds have been constructed near others to impound the runoff. Soil chemical data have been obtained for samples taken to a depth of 12 feet beneath a playa which has caught feedyard runoff since 1967. These data have been compared to those from an adjacent non-feedyard playa. Nitrate, nitrite, chloride, and soil water were similar in both playas in 1969 and 1974; changes in the feedyard playa were slight from 1969 to 1974. Three soil sealing treatments were compared in three newly constructed holding ponds. The treatments were a clay liner, incorporated bentonite, and check. After the initial impoundment of runoff, water loss rates were similar for all basins. After 45 days from initial filling, the water loss rate approximated the evaporation rate. These studies show that seepage rates beneath feedyard runoff catchments are low and seepage from runoff catchments presents little danger of ground water contamination. (Clark-USDA Southwestern Great Plains Research Center)

2672-A3, B5, C2, E2

### NUTRIENT LOSSES FROM MANURE UNDER SIMULATED WINTER CONDITIONS,

Agricultural Engineering Department, University of Wisconsin, Madison
T. S. Steenhuis, G. D. Bubenzer, and J. S. Converse
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 291-295.

Descriptors: Winter, Agricultural runoff, Temperature, Precipitation, Nitrogen.
Identifiers: Land spreading, Nutrient losses.

Pollution caused by winter spreading of manure has received wide publicity. Research information necessary to quantify the effects of climatic factors on the rate of nutrient losses under winter conditions is needed. This research was undertaken to determine the effects of temperature and precipitation on the rate of nutrient transformation from winter spread manure and the surface transport mechanisms that take place during the runoff cycle. To examine the pollution potential of winter spread manure with and without the effect of underlying soil layer, sample plots were covered with 20 cm of snow. Manure was applied as a urine-straw mixture or faeces at three depths within the snow layer. Plots were subjected to four cyclic temperature variations ranging from -8 degrees C to 12 degrees C in an environmental chamber. Radiation conditions equivalent to a cloudy late January day were simulated. At the end of the snow melt period, plots were subjected to simulated rainfall. Eighty to ninety per cent of the nitrogen was lost in the runoff from the snow with a water equivalent of 3 cm, when the urine-straw mixture was placed at the base or midpoint of the snow. Placement at the top resulted in only 10 to 15 per cent of the originally applied N in the meltwater. Losses in runoff from simulated rain were inversely related to the amount lost in the snow melt. Five to twenty-five per cent of the nitrogen of the faeces was lost in the snow melt process. The higher percentages were obtained for placement at the center and on top of the snow pack and subjected to a daily freezethaw cycle. Nitrogen losses from faeces were approximately 10 to 15 per cent of the initial load when subjected to the simulated rain. (Steenhuis, et. al.-University of Wisconsin; Merryman, ed.)

2673-A5,A6,A8,B2,C2,E2

### ANIMAL WASTE CONTRIBUTION TO NITRATE NITROGEN IN SOIL,

The Pennsylvania State University, 218 Tyson Building, University Park, Pa. 16802
L. F. Marriott and H. D. Bartlett
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 296-298.

Descriptors: Liquid wastes, Dairy industry, Crop response, Soil water, Groundwater pollution, Nitrogen, Sampling, Lysimeters, Nitrates.
Identifiers: Soil injection, Application rates.

Liquid dairy manure was injected on plots of orchardgrass at rates to supply 700-3500 pounds of nitrogen per acre per year for three successive years, and on orchardgrass, bluegrass and corn at rates to supply 200-600 pounds of nitrogen per acre. The concentration of nitrate nitrogen in soil water was determined on samples from suction lysimeters installed at depths of 1, 2, 3 and 4 feet. Crop yields were recorded and samples analyzed to measure nitrogen uptake. Soil samples to a depth of 4 feet were analyzed for nitrate and Kjeldahl nitrogen. The subsurface injection method provided complete control of malodors at the disposal site. Repeated applications of the high rates of manure resulted in increasing concentration of nitrate nitrogen in soil water at all depths of sampling. After applications were discontinued, there was a gradual reduction in nitrate nitrogen concentration with depth from 1 to 4 feet and with rate. The disappearance of the nitrate nitrogen from depths below the root zone indicates the potential for movement into ground water supplies. Manure rates supplying 300-600 pounds nitrogen per acre on bluegrass and orchardgrass increased the concentration of nitrate nitrogen in soil water at 3-4 feet to approximately two times the limit for potable water as set by the Public Health Service. The nitrate nitrogen level decreased 50 per cent in the next growing season. These results are further evidence that the rate of application of animal waste must be adjusted to the crop requirements for N and to soil conditions to minimize the loss of nitrate nitrogen from the root zone. (Marriott & Bartlett-Pennsylvania State University; Merryman, ed.)

2674-A3,A4,C2,C3,E2

### EFFECTIVENESS OF FOREST BUFFER STRIPS IN IMPROVING THE WATER QUALITY OF MANURE POLLUTED RUNOFF,

Department of Agronomy, University of Maryland, College Park
R. C. Doyle, D. C. Wolf, and D. F. Bezdicek
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 299-302.

Descriptors: Agricultural runoff, Coliforms, Streptococcus, Nutrients, Water quality, Water pollution.
Identifiers: Land spreading, Forest buffer zones, Dairy manure.

With today's environmental concerns, it is necessary to carefully evaluate the pollution potential of land spreading of manure. The objectives of this experiment were to determine the movement of fecal coliform, fecal streptococcus, total soluble P, K, Na, $NO_3$-N, $NH_4$-N, and organic-N in runoff water from manured land and establish the effectiveness of forest buffer zones in improving the water quality of manure polluted runoff. Dairy manure was applied at the rate of 90 metric tons per hectare, 69 per cent moisture, on 0.19 hectare of a Chester gravelly silt loam soil (Typic Hapludult; fine loamy, mixed, mesic) having a 4 per cent slope and planted in alfalfa. The experimental site was located in the Piedmont physiographic province of Maryland. Runoff was collected from a 35-40 per cent slope forest by means of dust pan lysimeters at 0.0, 3.8, 7.6, 15.2, and 30.5 meter intervals from the manured area. Runoff samples were taken for four natural rainfall events after an initial August, 1973 manure application. A second 90 metric tons per hectare of manure was spread in November, 1973 and runoff from three subsequent rains was collected. Runoff at 0.0 meters displayed high concentrations of P, K, Na, and total N, but fecal coliform and fecal streptococci densities were not significantly higher than background levels. Runoff from the manured area was most highly contaminated in the first rain after manure application, and the runoff water quality showed a tendency to improve with each additional rain. The degree of pollution in the runoff collected at 0.0 meters increased during the winter. Fecal pollutants in runoff water or soil collected at distances of 3.8 meters or greater could not be substantiated by either the biological or chemical parameters measured. Similarly, no effect on the stream adjacent to the plot area was observed during the experiment. (Doyle, et. al.-University of Maryland)

2675-A5,B2,C2,C3,D3,E1

### EFFECT OF ANAEROBIC SWINE LAGOONS ON GROUNDWATER QUALITY IN HIGH WATER TABLE SOILS,

Agricultural Engineering Department, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
E. R. Collins, Jr., T. G. Ciravolo, D. L. Hallock, D. C. Martens, H. R. Thomas, and E. T. Kornegay
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 303-305.

Descriptors: Lagoons, Anaerobic conditions, Coastal Plains, Sampling, Chemical properties, Biological properties, Nutrients, Coliforms.
Identifiers: Swine, Groundwater quality, High water table soils.

The effect of anaerobic swine lagoons on the quality of groundwater in the Coastal Plains was investigated at the Virginia Swine Evaluation Station (VSES) and at the Tidewater Research and Continuing Education Center (TRACEC). The lagoons are located on soils with high water tables near Suffolk, Virginia. Chemical and biological tests were conducted on groundwater sampled at various depths and distances from the lagoons. Constituents determined were nitrates, ammonia, soluble orthophosphates, chlorides, chemical oxygen demand, manganese, copper, zinc, calcium, potassium, magnesium, sodium, and fecal coliform. Wells were water-jetted to 10-, 15-, and 20-foot depths at 10-, 50-, and 100-foot distances from the lagoons. Groundwater samples were taken monthly since August, 1973. The wells were purged one day before sampling. Samples for chemical analysis were stored under ice and dry ice in the field and transferred to a freezer in the laboratory. Before chemical analysis, the samples were filtered through a 0.45 micron filter. The biological determinations were initiated shortly after sampling. Data from the wells at TRACEC indicated influences other than the lagoon on groundwater quality. For this reason, these wells have been abandoned. A new lagoon has since been constructed at this location. Future work will entail monthly monitoring of the groundwater around the new lagoon at TRACEC, monitoring of groundwater around a lagoon on a private farm, and more intensive monitoring of groundwater at VSES with the establishment of more wells. (Collins, Jr. et. al.-Virginia Polytechnic Institute and State University; Merryman, ed.)

2676-A8, B2, C3, D3, E2

### NUTRIENT CHARACTERISTICS OF WASTES FROM DEEP PITS AND ANAEROBIC LAGOONS,

Agricultural Engineering Department, Iowa State University
J. C. Lorimor, S. W. Melvin, and B. M. Leu
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, Uni-

versity of Illinois, Urbana-Champaign, April 21-24, 1975, p. 306-308.

Descriptors: Lagoons, Bacteria, Analysis, Sediments, Water, Coliforms, Pathogens.
Identifiers: Land disposal.

Bacterial populations in lagoon water and subsequent disposal of these waters were studied for one year. The objectives of the study were: To establish relationships between the lagoon sediments and the overlying water of certain groups of bacteria, the isolation of pathogenic organisms from the lagoon sediment and water, the survival of certain indicator bacteria, and the effect of land disposal of lagoon waste water. The fecal coliform populations were found to be 10 times greater in the sediments than in overlying water. Aerobic spore-forming bacillus populations were found to be 10 to 100 times greater in the sediments than the overlying water. Fecal streptococcal populations did not vary appreciably during the winter months; however, a 1 to 3 fold increase in the sediment was noted during the summer months. Fecal streptococcal populations were found to survive longer in lagoon water than the fecal coliform populations. Pathogenic organisms, such as Salmonella and coagulase-positive Staphylococcus were more frequently isolated from the sediments than from the overlying waters, indicating that sediments should not be disturbed when disposing of lagoon water. A steady increase in fecal coliform and fecal streptococci populations occurred on the land designated for disposal. The fecal streptococci were found to survive longer in the soil than the fecal coliforms. The results indicate that fecal bacteria are able to survive competition from soil organisms for extended periods of time. (Lorimor, et. al.-Iowa State University; Merryman, ed.)

### 2677-B2, C2, D2, E3, F6

### NITROGEN REMOVAL AND RECOVERY FROM POULTRY WASTEWATER BY ION EXCHANGE,

Southeast Environmental Research Laboratory, U.S. Environmental Protection Agency, College Station Road, Athens, Georgia 30601
L. A. Mulkey
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 309-313.

Descriptors: Poultry, Waste water treatment, Ion exchange, Recycling, Effluents, Aerobic treatment, Equations.
Identifiers: Nitrogen recovery.

An ion exchange process to remove and recover nitrogen from poultry waste-water was investigated. Wastewaters were characterized to determine the feasibility of ion exchange treatment in a close-loop aerobic treatment system and exchange isotherms were generated in laboratory studies. A strong acid cationic H-form macroreticular resin was chosen to investigate removal of $Nh_4^+$. $HNO_3$ was chosen as a regenerant to yield a mixed nitrate salt solution by-product of $NH_4^+$, $K^+$, $Ca^{++}$,and $Mg^{++}$in excess acid. Flow direction, wastewater concentrations, and acid strengths were varied to determine optimum operating conditions. Ion exchange columns operated in an up-flow fluid-bed mode resulted in essentially complete resin utilization. No $NH_4^+$leakage was detected until breakthrough at near saturation values. Mass transfer and equilibrium constants for wastewater feed were independent of $NH_4^+$concentrations over a range of 400-2200 mg/1. Similar constants were determined for regeneration and were found to vary over a $HNO_3$ concentration range of 0.5-4N. Design equations and the laboratory determined mass transfer; equilibrium data were used to size a full-scale system. An equation to predict the excess quantities of $HNO_3$ required for regeneration was derived and tested against the data. The buffering capacity of wastewater was found to sufficient for complete recycle of the treated (low pH) column effluent. (Mulkey-EPA)

### 2678-C2, D2, D3, E1

### OXIDATION-NITRIFICATION AND DENITRIFICATION OF VEAL CALF MANURE,

Institute for Soil Fertility, Hasen, The Netherlands
H. G. Van Faassen, H. Van Dijk
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 314-317.

Descriptors: Fermentation, Nitrification, Nitrites, Nitrates, Economics, Cattle.
Identifiers: Phosphate removal.

Experiments were done utilizing laboratory fermentors (2 to 20 liters). Information about COD and NOD of manure was presented. Until now, for complete denitrification a minimum C/N ratio of 6 was supposed to be necessary. In these experiments, a C/N of 1.7 proved to be sufficient. Nitrification to nitrite is more economical than nitrification to nitrate. In the experiment, removal of more than 95 per cent of the nitrogen was possible. Adding certain amounts of Ca $(OH)_2$ did not harm the biological process and resulted in a phosphate removal of about 90 per cent. (Van Faassen-Netherlands)

### 2679-A8, B2, C3, D3, E2

### BACTERIAL ANALYSIS AND LAND DISPOSAL OF FARM WASTE LAGOON WATERS,

Department of Bacteriology, North Dakota State University, Fargo, North Dakota
D. R. Smallbeck, M. C. Bromel
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 318-321.

Descriptors: Lagoons, Bacteria, Analysis, Sediments, Land disposal, Water, Coliforms, Pathogens.

Bacterial populations in lagoon water and subsequent disposal of these waters were studied for one year. The objectives of the study were: To establish relationships between the lagoon sediments and the overlying water of certain groups of bacteria, the isolation of pathogenic organisms from the lagoon sediment and water, the survival of certain indicator bacteria, and the effect of land disposal of lagoon waste water. The fecal coliform populations were found to be 10 times greater in the sediments than in overlying water. Aerobic spore-forming bacillus populations were found to be 10 to 100 times greater in the sediments than the overlying water. Fecal streptococcal populations did not vary appreciably during the winter months; however, a 1 to 3 fold increase in the sediment was noted during the summer months. Fecal streptococcal populations were found to survive longer in lagoon water than the fecal coliform populations. Pathogenic organisms, such as Salmonella and coagulase-positive Staphylococcus were more frequently isolated from the sediments than from the overlying waters, indicating that sediments should not be disturbed when disposing of lagoon water. A steady increase in fecal coliform and fecal streptococci populations occurred on the land designated for disposal. The fecal streptococci were found to survive longer in the soil than the fecal coliforms. The results indicate that fecal bacteria are able to survive competition from soil organisms for extended periods of time. (Smallbeck-North Dakota State University)

### 2680-B1, C1, C3, F6

### A MYCOLOGICAL INVESTIGATION OF BEEF FEEDLOT MANURE IN A SEMIARID TEMPERATE CLIMATE,

Research Station, Agriculture Canada, Lethbridge, Alberta, Canada T1J 4B1
R. G. Bell
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 322-324.

Descriptors: Fungi, Decomposing organic matter.
Identifiers: Unpaved feedlots, Dilution plate technique.

An investigation was undertaken to determine the magnitude, composition, origin, and ecological significance of the fungi present in manure on the surface of an unpaved beef feedlot. Enumeration and isolation were accomplished using the dilution plate technique at incubation temperatures of 25, 37, and 55 degrees C on Rose Bengal-streptomycin-supplemented Sabourard's, Czapek-Dox, and Manure Extract agars. The only thermophilic fungi isolated were Thermomyces lanuginosus, a Talaromyces (Penicillium) sp., a Mucor sp., and Chaetomium thermophile var. coprophile. With the exception of the Chaetomium, all were also present in the feed. The number of thermophiles remained almost constant throughout the investigation, which probably indicates their presence as spores. The dominant fungi isolated at 25 degrees C were members of the Mucorales, typical of early stages of organic matter decomposition. A direct relationship between moisture content and fungal population was observed; the extremes were 500 and 21,000 propagules-g dry manure at 10.5 and 55.2 per cent moisture content, respectively. This numerical change was accompanied by redistribution of population from a 100:1 predominance of Mucorales over Moniliales at high moisture content to a 1:1 ratio at low moisture content. At 10.5 per cent moisture content, the Moniliales (250/g dry manure) all Aspergillus sp., were shown by differential medium of Bothast and Fennell to be potentially aflatoxic. Similar strains were isolated from the feed. Laboratory studies indicated that feedlot manure under conditions favorable to decomposition, 65 per cent water content, supported 350,000, 250,000 and 3000 propagules/g dry manure at 25, 37, and 55 degrees C, respectively. This observation, coupled with the characteristic low moisture content found in surface manure samples, supports the hypothesis that little decomposition is effected, by the mainly feed-originating fungi, on the feedlot surface. The potential hazard of aflatoxin production is, therefore, minimal on a dry feedlot but should not be overlooked when considering ultimate manure disposal. (Bell-Canada; Merryman, ed.)

### 2681-B5, D2, E3, F5

### MODIFICATION AND ENZYMATIC HYDROLYSIS OF FEEDLOT WASTE,

Department of Microbiology, Colorado State University, Fort Collins 80523
C. K. Elmund, D. W. Grant, and S. M. Morrison
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 325-327.

Descriptors: Hydrolysis, Feedlots, Nutrition.
Identifiers: Farm wastes, Refeeding, Fenton's Reagent, C. utilis.

Various environmental and economic factors have emphasized the need to develop processes for increasing the biodegradability of cattle feedlot manure and for upgrading its nutritional value for refeeding. A rate-limiting factor during microbial decomposition of manure is the depolymerization of the cellulosic fraction, a major constituent of feedlot waste. One phase of our research project is the evaluation of Fenton's Reagent (FR) to partially depolymerize the cellulosic fraction to facilitate its enzymatic hydrolysis to reducing sugars. The products may subsequently serve as substrates for the growth of microorganisms for feed supplements or other economically valuable products. The objectives of our study include optimizing conditions for FR-catalyzed depolymerization and enzymatic hydrolysis of the cellulosic fraction, producing feed yeast on reacted manure substrate, and evaluating the nutritional value of the resulting product. A description of research procedures is given. Preliminary results suggest that manures reacted with Fenton's Reagent and cellulase are suitable substrates for the growth of C. utilis. Manures processed in this manner may serve as nutritionally valuable supplements in proposed refeeding systems. (Elmund, et. al-Colorado State University; Merryman, ed.)

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2682-A8, A11, B5, E2

### INFLUENCE OF ANTIBIOTICS AND GROWTH PROMOTING FEED ADDITIVES ON THE MANURING EFFECT OF ANIMAL EXCREMENTS IN POT EXPERIMENTS WITH OATS,

Institut fur Pflanzenbau und Saatgutforschung der Forschungsanstalt fur Landwirtschaft, Braunschweig-Volkenrode, D33 Braunschweig, Bundesallee 50, Federal Republic of Germany.
C. Tietjen
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 328-330.

Descriptors: Antibiotics, Additives, Feeds, Performance, Crop response, Biodegradation.
Identifiers: Feed conversion efficiency.

Supplementation of animal feed by antibiotics and other additives is aimed at increase of weight gains, increase of feed conversion efficiency and maintenance or restoration of animal health. High stability is demanded of antibiotics; no resorption in the alimentary canal shall occur. Consequently, they are excreted and need consideration in animal waste disposal. In experiments of G. K. Elmund et. al. (1971), 75 per cent of the dietary chlortetracycline was excreted; antibiotic supplementation apparently altered the digestive processes in the animal, resulting in less biodegradable feces, thus increasing the environmental pollution potential. Application of antibiotics in plant nutrition and plant protection influences crop growth in manifold ways. In pot experiments with oats, we applied aureomycin, bacitracin, and streptomycin to the soil; they did not affect dry matter production and nitrogen content. But applied together with two varieties of chicken manure, dry matter production decreased; content was increased; 71 per cent in grain, 95 per cent in straw. In similar pot experiments, pooled fresh excrements from broilers and from pigs were used which were collected during investigations on the nutritive effect of supplementation with carbadox, oleandomycin, oxytetracyclin, flavomycin, virginiamycin, zincbacitracin, peson, and quindoxin. As interaction with increasing rates of nitrogen fertilizer, we observed hindering as well as furthering of crop growth. Remarkable increase of dry matter production was caused by carbadox; higher nitrogen contents were related to flavomycin, oxytetracyclin and oleandomycin. Dietary supplementation by antibiotics and other kinds of additives may modify the biodegradation of the excrements as well as their manuring effect in crop production. (Tietjen-Institut fur Pflanzenbau und Saatgutforschung der Forschungsanstalt fur Landwirtschaft)

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2683-B2, E1, F5

### OPTIMUM DILUTION OF SWINE WASTES FOR GROWTH OF LEMNA MINOR L. AND EUGLENA SP,

Environmental Biology Branch in cooperation with Agricultural Resource Development Branch, Tennessee Valley Authority, Muscle Shoals, Alabama 35660.
R. A. Stanley and C. E. Madewell
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 331-333.

Descriptors: Fish diets, Algae, Oxygen.
Identifiers: Swine, Anaerobic lagoon, Fish production, Tennessee Valley Authority, Pond enrichment, Loading rates, Phytoplankton.

One means of animal waste disposal is the use of wastes to enrich enclosed ponds for increased production of fish or shellfish. This approach is being used at Woods Hole Oceanographic Institute for marine shellfish, and should work equally well for freshwater systems. Three possible systems that TVA intends to test are (1) Lemna minor L. (or some other duckweed) consumed by white amur, (2) algae consumed by a freshwater shellfish, and (3) algae consumed by phytoplanktivorous fish such as silver amur. The proper dilution rate for L. minor L. and phyto-plankton was determined in glazed ceramic containers under greenhouse conditions. Containers held 8 l of fluid and had 350 cm$^2$ surface area. Fluid for waste enrichment was obtained from a local primary treatment lagoon (anaerobic) that receives wastes from a swine feeding operation. Additions were made three times per week. L. minor L. from a local pond was added at 10 g fresh weight per container. Inocula for phytoplankton were obtained from a dilution series that had been spiked with seven water samples containing natural phytoplankton flora. About 2 g fresh weight of mixed phytoplankters was used to innoculate the experimental dilution series. Plants were harvested once a week, dried overnight at 70 degrees C, and weighed. Oxygen was determined with a YSI model 53 oxygen monitor. Loading rate for optimum growth of L. minor L. was 19 ml/l/wk. Dissolved oxygen during the day at this loading rate was normal (saturated), while at night oxygen was about one-half saturated (4.8 PPM). Maximum growth of Euglena-sp. was obtained at the highest loading rate tested 150 ml/l/wk. Day and night oxygen concentrations at this loading rate were below 2ppm, a level reported to be tolerated by Asiatic clams and silver amur but considered dangerously low. The highest loading rate used at which dissolved oxygen remained above 2ppm, both day and night, was 38 ml/l/wk. (Stanley and Madewell-TVA; Merryman, ed.)

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2684-A11, B2, C3, D3, F3

### SWINE WASTE LAGOONS AS POTENTIAL DISEASE RESERVOIRS,

Department of Veterinary Pathology, Iowa State University, Ames, Iowa.
R. D. Glock and K. J. Schwartz
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 334-335.

Descriptors: Lagoons, Diseases, Pathogenic bacteria, Liquid wastes, Recirculated water, Salmonella.
Identifiers: Swine, Flushing gutter systems, Dysentery.

Swine waste lagoons and pits have been rapidly increasing in numbers due to their practicality. The design, construction, and use of these systems has been quite thoroughly described but the question of whether pathogenic organisms can persist in liquid waste and act as biological hazards has not been adequately considered. Systems utilizing recirculation of lagoon effluent in flushing gutter systems would seem to be especially hazardous. Two groups of 3 pigs each were deprived of fresh water but were fed anaerobic lagoon effluent from gutter-flush tanks on a farm with a history of swine dysentery and salmonellosis. Two similar groups were held as controls with free access to clean water. This study revealed that effluent used to flush gutters was capable of initiating S. st. paul infections and clinical swine dysentery. Salmonella st. paul was also isolated from the lagoon effluent. T. hyodysenteriae-like organisms were observed in low numbers but isolation attempts failed. Further surveys of swine waste lagoons and pits resulted in isolation of Salmonella from 4 to 13 anaerobic lagoons and from 1 of 3 sub-floor pits. Serotypes isolated included S. molade, S. st. paul, S. typhimurium, S. manhattan, and S. agona. Pathogenicity of the various serotypes isolated is not known but it seemed significant that, in 2 instances, the same serotypes were isolated both from lagoon effluent and from rectal swabs of swine on the same premises. There was some indication that isolations of Salmonella were more frequently accomplished during the colder seasons. These findings do not suggest that anaerobic lagoons are undesirable but that more study is needed to determine specific disease transmission hazards. The potential of swine wastes as Salmonella reservoirs also needs further clarification. (Glock & Schwartz-Iowa State University; Merryman, ed.)

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2685-A11, B1, B5, C2, E2

### EXCRETION OF SALTS BY FEEDLOT CATTLE IN RESPONSE TO VARIATIONS IN CONCENTRATIONS OF SODIUM CHLORIDE ADDED TO THEIR RATION,

Robert S. Kerr Environmental Research Laboratory EPA, P. O. Box 1198, Ada, Oklahoma
L. R. Shuyler, D. A. Clark, J. Barth, and D. D. Smith.
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 336-338.

Descriptors: Salts, Feedlots, Diets, Cattle, Performance, Soil contamination.
Identifiers: Land disposal.

The Robert S. Kerr Environmental Research Laboratory (RSKERL) and the National Environmental Research Center, Las Vegas (NERC-LV), with the concurrence of the Nevada Operations Office of the Atomic Energy Commission (AEC), jointly conducted a study of feedlot cattle maintained on an experimental farm at the Nevada Test Site (NTS) to determine the effect of different salt supplementation regimes on the production of beef and on the total excretion of salt in the animal wastes. The practice of including sodium chloride (NaC1) in the diet of feedlot cattle at levels greater than 0.5 per cent has caused salt accumulations in soils used for animal waste disposal in arid regions of the U.S. In this study, a feedlot diet of ground alfalfa, ground grain sorghum, cottonseed meal, and limestone was supplemented with different NaC1 levels (0.5 per cent, p. 25 per cent, and 0 per cent). Urine and fecal samples were collected from cattle being fed controlled amounts of NaC1 and analyzed for NaC1 and other important parameters. Samples of feed and water were also analyzed for the same parameters. The animals used in this study were sacrificed, and grade and yield of the carcasses were determined. The rate of gain and conversion efficiency were also measured. The study indicated that salt content in feedlot ration was reduced below the 0.5 per cent level without affecting beef production. The NaC1 content in the waste decreased as the NaC1 content of the feed was reduced. These results indicated that land loading rates for animal waste disposal in areas where salt is the limiting factor may be increased by lowering the salt content of the feed. (Shuyler-Robert S. Kerr Environmental Research Center)

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2686-B1, C1, C2, D1, E3

### PARTICLE-SIZED DISTRIBUTION OF LIVESTOCK WASTES,

Assistant Professor, Department of Soil Science, California University, Riverside
A. C. Chang, and J. M. Rible
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 339-343.

Descriptors: Separation techniques, Feeds, Value.
Identifiers: Refeeding.

In recent years, animal wastes from confine feeding operations have often been considered as a source of feed or feed supplements. There were many feed trials to determine the response of animals with mixed results. In general, it is recognized that small amount of manure additive in feed is not harmful to the animal. However, there are also serious drawbacks of such feeds due to certain unfavorable constituents in the waste. It is the belief of the authors that certain portion of the waste could become valuable feed to the livestock animals. The purpose of this study is to physically separate the waste into various fractions according to particle size and determine the feed value of each fraction. For this purpose, various aged and freshly collected animal waste samples were collected from confine feeding beef feedlots, dairies and poultry ranches for the analysis. A vibrating sieve shaker was used to separate the aged dry waste samples. The freshly collected wastes were separated by a wet sieving technique. Crude fiber, protein, fat, nitrogen free extracts, ashes, and moisture contents were determined to calculate the total digestible nutrient. Amino acid and organic acid compositions are also determined to assess their potential as feedstuff. (Chang-California University)

## 2687-A6, B1, C1, C2, E3

### DECOMPOSITION RATES OF BEEF CATTLE WASTES,

Department of Agricultural Engineering, Colorado State University, Fort Collins
M. L. Stone, J. M. Harper, R. W. Hansen
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 344-346.

Descriptors: Organic wastes, Cattle, Recycling, Chemical properties, Physical properties, Odor, Feedlots.
Identifiers: Decomposition rates, pH.

Manure has gained importance as a source of feed, fertilizer, and energy. This study describes the physical and chemical changes that occur in manure from the time it is deposited to the time it is picked up for utilization. The major objective of this study is to evaluate the waste of this resource due to decomposition. A controlled temperature-humidity chamber was used to incubate manure at constant temperature and moisture levels. During incubation the manures were monitored. Chemical properties monitored were total nitrogen, protein nitrogen, $NH_3N$, acid detergent fiber, ash, and pH. Physical properties monitored were odor, bulk density, particle size, viscosity, and squeezability. The effect of manure decomposition was greatest on its viscosity and squeezability. The viscosity of a slurry of manure incubated at 70 per cent moisture content and 120 degrees F doubled in a ten day period. The manure's squeezability decreased 6 per cent in the same period. In contrast, bulk density and particle size remained the same. Change in odor closely corresponded to pH change. The pH decreased the first two days and then increased the rest of the 10 day incubation period. Other chemical properties excluding ammonia showed little change in high moisture (70 per cent) manure incubated at high temperature (120 degrees F). At low temperatures, neither physical or chemical properties changed as would be expected. Data indicate that chemical changes of manure are relatively slow compared to some of the changes in physical properties. This may have a profound impact on manure slurry handling systems and on collection frequency necessary to obtain optimum benefit from manure. (Stone-Colorado State University; Merryman, ed.)

## 2688-A2,A8,B1,B5,C2,E2

### CHEMICAL CHARACTERISTICS OF BEEF FEEDLOT MANURES AS INFLUENCED BY HOUSING TYPE,

Assistant Professor, Department of Crop and Soil Sciences, Michigan State University, East Lansing
D. C. Adriano
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 347-350.

Descriptors: Feedlots, Chemical properties, Climates, Michigan, Cattle, Nutrients, Salts.
Identifiers: Housing types.

Climate influences decomposition of manure and transformation of its constituents. Housing types in feedlots modify climatic influence, and thus, could affect decomposition and composition of manures. There are three major feedlot housing types in Michigan: open-lot, dry-lot, and the total-confinement systems. Six feedlots in southern Michigan, with one or more housing type, were chosen to evaluate: (1) chemical composition, with emphasis on N, P, and K, of fed beef cattle manures as affected by various housing types, and (2) $NO_3$ and salt status of farms receiving these manures. These feedlots had various manure scraping frequency and a wide range of animal density and size. Manure and fresh fecal samples were collected four times at bimonthly intervals from spring to fall of 1973. Soil samples to 2 ft. deep from manured and unmanured areas were collected four times during the corn growing season. The organic matter contents of manures indicate its degree of exposure to climate. In lots with more favorable evaporative conditions, organic matter was high, on gravimetric basis. This was true in open-lots, followed by dry-lots. But in total-confinement with slotted floor, organic matter was low. The N contents of manures from open-lots were generally low, with an average of 1.1 per cent (dry-basis). Manures from dry-lot and total-confinement systems had more than twice the N of open-lot manures. This pattern suggests that greater amounts of N were lost from open-lots, possibly largely by $NH_3$ volatilization. In open-lots P tended to be lower in manure than in fresh feces, probably caused by runoff or leaching losses. However, in dry-lot and total-confinement systems, P in fresh feces and manures was about equal. Potassium was generally low in open-lot manures. On the average, fresh feces had lower K than manures. Data for Ca, Mg, Na, Fe, Mn, Zn, and Cu is also discussed. Field data show generally higher levels of $NO_3$ and C1 in soils in manured than control areas. However, no significant salt buildup was detected. (Adriano-Michigan State Univ; Merryman, ed.)

## 2689-A6, A7, C2

### IDENTIFICATION AND MEASUREMENT OF VOLATILE COMPOUNDS WITHIN A SWINE BUILDING AND MEASUREMENT OF AMMONIA EVOLUTION RATES,

Department of Agricultural Engineering, Oregon State University, Corvallis, Oregon 97331
J. R. Miner, M. D. Kelly, and A. W. Anderson
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 351-353.

Descriptors: Odor, Confinement pens, Ammonia, Measurement.
Identifiers: Swine, Volatile compounds.

This project was initiated to find a practical way of identifying and monitoring odorous volatiles. Volatile compounds produced in a swine confinement building were trapped by porous polymers and identified by combined gas-liquid chromatography and mass spectrometry. Gas-liquid chromatograph outputs were used as the basis for estimating concentrations. Air from a swine center was drawn through traps containing either Tenax GC or Poropak Z. The traps were first heated to 55 degrees C for one hour to remove water and then reversed and reheated at 150-200 degrees C to remove trapped volatiles. The entrained volatiles were transferred to an open tubular stainless steel trap immersed in dry ice. The small cold traps were then connected to the gas chromatograph and-or mass spectrometer by modified inlet systems. About 25 compounds were identified by this method, including organic acids: acetic, propionic, butyric, and valeric. Their concentrations were determined by using an integrator attached to the chromatograph. They were all found to be in the 10-6 ug-1 range. This technique was then used to measure the evolution rate of ammonia as well as the transport properties of these compounds upon release. Native grasses, soil and surface water were all demonstrated to have significant ammonia absorption properties. Values for dairy barn floors, feedlot surfaces, manured fields and lagoon surfaces are reported. (Miner, et. al.-Oregon State University; Merryman, ed.)

## 2690-A6, C2

### QUANTATIVE MEASUREMENT AND SENSORY EVALUATION OF DAIRY WASTE ODOR,

Battelle's Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201
C. N. Ifeadi, E. P. Taiganides, and R. K. White
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 354-357.

Descriptors: Odor, Measurement.
Identifiers: Dairy wastes, Volatile compounds, Diethyl sulfide, Dimethyl sulfide.

Instrumentation for the quantitative measurement and sensory evaluation of odor is developed. The system comprises (1) a sample collector, (2) a sample injection system, (3) gas chromatograph (GC), and (4) dilution system consisting of a diffusion cell, series of rotameters, and a sniffing hood. Dairy waste odorous compounds are collected with the sample collector at ambient conditions. The injection system is a specially designed apparatus for transferring the samples from the collector into the GC for identification and quantification. The diffusion cell which was placed in a constant temperature medium is used to diffuse calibrated amounts of odorants into the dilution system. Rotameters are used to dilute the odorants with odor free air so that different concentrations of the odorants may be analyzed by GC and evaluated organoleptically at the sniffing hood. Volatiles from dairy waste stored in a diluted and undiluted state are analyzed. Dimethyl sulfide and diethyl sulfide are quantified. Average concentration for analyses of the diluted manure volatiles are 0.3 ppm for diethyl sulfide, and 65.4 ppm for dimethyl sulfide; while the volatiles from the undiluted are 2.7 ppm for diethyl sulfide and 34.9 ppm for dimethyl sulfide. Sensory evaluation showed that the odor threshold of the diluted dairy waste was lower than the undiluted waste by a factor of ten. (Ifeadi, et. al.-Battelle's Columbus Laboratories, etc.)

## 2691-A6

### EVALUATION OF ODOR INTENSITIES AT LIVESTOCK FEEDING OPERATIONS IN TEXAS,

Agricultural Engineering Department, Texas A&M University, College Station 77843
D. L. Reddell and J. M. Sweeten
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 358-361.

Descriptors: Feedlots, Texas, Cattle.
Identifiers: Odor measurement, Odor intensity standards, Vapor dilution, Liquid dilution, Scentometer, Swine.

An experiment was conducted to correlate results from two odor measurement techniques—vapor dilution and liquid dilution. A scentometer was used to measure odors at both a cattle feedlot and a swine operation. Manure samples from these operations were brought into the laboratory and the odor intensity was measured using a liquid dilution technique. The odor readings determined by each panel member for several months were plotted as probability distribution functions. Using Monte Carlo simulation techniques, a composite probability distribution of odor intensity for the entire panel was predicted and shown to correlate with the field and laboratory measurements. Using probability distributions, a correlation between the field readings obtained with a Scentometer and the laboratory readings using the liquid dilution method was explored. Odors were measured using a Scentometer at three Texas cattle feedlots (400, 12,000 and 30,000 head capacities). Within each feedyard, odors were also monitored along side the runoff retention ponds at one feedlot. Diverse conditions of weather, drainage, and manure management were encountered. Odor intensity frequency distributions were developed for each feeding operation. These revealed that the feedlots would have exceeded odor intensity standards of 7 to 8 $D_t$ (in effect in four states) from 40 to 85 per cent of the time. However, the 127$D_t$ standard for two states would have been exceeded no more than 5 per cent of the time. The authors concluded that the minimum odor level that can reasonably be expected at cattle and swine feeding operations is 7 $D_t$. (Reddell & Sweeten-Texas A&M; Merryman, ed.)

### 2692-A7, A11, B1, B2, C2

### MANURE GASES AND AIR CURRENTS IN LIVESTOCK HOUSING,

Swedish Institute of Agricultural Engineering, S-750 07 Uppsala 7, Sweden
Sven-Uno Skarp
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 362-365.

Descriptors: Livestock, Ventilation, Hydrogen sulfide.
Identifiers: Sweden, Manure gases, Confinement buildings.

In Sweden, liquid handling of livestock wastes from confinement buildings developed during the early 1960's. It gradually became clear that gas formation from the liquid manure could be a problem. Several serious gas poisoning accidents among pigs and cattle drew attention to this fact. Studies were made by the Swedish Institute of Agricultural Engineering into the presence and distribution of manure gases under different conditions. The following conclusions were derived from these studies. The main factors for the distribution of gases were temperatures and air currents. Solid manure did not release gases in quantities injurious to animals or humans. Liquid manure released gases, of which hydrogen sulfide sometimes appeared in toxic concentrations. Static liquid manure released hydrogen sulfide in measurable quantities only if the manure originated from pigs. Liquid manure handled or set in motion by pumping, mixing, spreading or cleaning-out released large amounts of gases, particularly hydrogen sulfide. The normal ventilation design was found to have a great influence on the distribution of manure gases. The largest problems were caused by currents of cold air at low heights due to ineffective mixing and distribution of the incoming fresh air from the air inlets. The design and location of air inlets and the way the air was distributed determined the climate in the livestock building. The design and location of the exhaust fans were of minor importance for the correct control of incoming fresh air. Balanced ventilation system gave the best conditions compared with systems of slight negative and positive pressure. (Skarp-Sweden)

### 2693-A6, A7, B1, B2, B4

### EXHAUST SYSTEMS FOR UNDERFLOOR LIQUID MANURE PITS,

Department of Agricultural Engineering, Maryland University, College Park
D. S. Ross, R. A. Aldrich, D. E. Younkin, G. W. Sherritt, and J. A. McCurdy
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 366-368.

Descriptors: Odor, Air pollution, Design, Ventilation.
Identifiers: Storage pits, Slotted floors, Exhaust systems.

Liquid manure storage pits in enclosed buildings with partially slotted floors can produce unpleasant and injurious odors for people and animals within the buildings. A method for removing such odors from a manure pit is to exhaust air from beneath the slotted floor directly to the outside of the building. Continuous ventilation should prevent gases from moving outside the pit area. Laboratory and field studies were made to find satisfactory exhaust systems which would provide effective odor control and acceptable air distribution and temperature. Laboratory studies of 100 ft. each of 6- and 8-inch diameter perforated plastic pipe were made. With a design flow of 4 cfm per ft. for the 6-and 8-inch diameter pipes with holes spaced 1 ft. apart. The standard deviations were 0.52 and 0.59 cfm, respectively, with the test values generally decreasing with distance from the exhaust fan. In the field installation, the odor control was satisfactory. Since it is not possible to install a perforated pipe system in all barns, an alternative was developed. A tapered duct was designed according to ASHRAE Guide Procedures which would permit all ventilation air to pass through the pit. Such as system was installed at the PSU Swine Research Center and monitored. Air distribution and temperature control were acceptable thoughout the winter period; however, odor control was not satisfactory because airflow through the pits during cold periods was not sufficient to prevent odors from entering the occupied zone. Providing a higher airflow by lowering the minimum temperature to 45 degrees F improved the odor control. (Ross, et. al.-Maryland and Pennsylvania; Merryman, ed.)

### 2694-A6, A7, B3, D2, D3

### MALODOR REDUCTION IN BEEF CATTLE FEEDLOTS,

Professor and Instructor, respectively, Department of Agricultural Engineering, Texas Tech University, Lubbock
W. L. Ulich and J. P. Ford
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 369-371.

Descriptors: Feedlots, Cattle.
Identifiers: Odor control, Chemical treatment, Manure pack.

An investigation was conducted in order to: (1) thoroughly review current odor control technology, (2) investigate various control treatments, and (3) provide practical odor control guidelines for confined beef cattle feedlots. Seven control materials were selected for detailed investigation. Preliminary laboratory tests consisted of one hundred grams of solid or one hundred milliliters of liquid samples to which various amounts of control materials were added. Sulfureous compounds, amines, and possibly ammonia were found to be common important components of cattle feedlot odors. Organoleptic tests or digestive deodorants were not found to prevent the release of any of the malodorous gases for which the tests were conducted. Digestive deodorants did effect time of release. Chemical treatments using hydrogen peroxide, paraformaldehyde, potassium nitrate, and various commercial formulas were found to provide some control at relatively high concentrations. These chemicals, however, were later judged to be more expensive at the required concentrations than other chemical control applications. Potassium permanganate and orthodichlorobenzine were estimated to significantly reduce malodors when sprayed in a 1 per cent water solution at rates of 20 pounds and 6 gallons per acre of feedlot respectively. In any odor control system good housekeeping cannot be over-stressed. Moisture control of the manure pack is much more important than the frequency of pen cleaning. A shallow porous, aerobic blanket of loose manure should be maintained over a 25-40 per cent moisture manure pack, where possible, for odor and dust control. Current recommendations consist of a critically controlled manure pack and a chemical spray plan as an emergency standby. (Ulich and Ford-Texas Tech; Merryman, ed.)

### 2695-A6, A10, B2, D2, D3

### THE USE OF DRIED BACTERIA CULTURES AND ENZYMES TO CONTROL ODOR AND LIQUEFY ORGANIC WASTE FOUND IN HOG, DAIRY, AND POULTRY PRODUCING UNITS AS WELL AS LAGOONS,

Big Dutchman, Division of U.S. Industries, Inc. 200 Franklin, Zeeland, Michigan
J. F. Bergdoll
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 372-373.

Descriptors: Liquification, Organic wastes, Lagoons, Enzymes, Additives, Dairy industry, Poultry.
Identifiers: Odor control, Dried bacteria cultures, Swine, Fly control.

Our object was to find cultured bacteria and enzymes that safely control ammonia and odors, reduce mass, and/or liquify organic waste. Different strains and levels of bacteria and enzymes were used on waste beneath cages, on feeding floors, in hog pits, and lagoons. Several oxidizing and neutralizing agents were added. Materials were applied as a spray or as a dust on liquid pits and lagoons. The treatments result in up to 50 per cent reduction of the BOD count in all cases; solids were liquified; and odors were reduced. In addition, drain-lines were kept clear of all organic waste build-up. Different products were used for general odor control and where manure or waste was being handled as a liquid. Proper utilization of products containing a minimum of 1½ billion anaerobic and 4 billion aerobic bacteria per gram plus enzymes and other additives; most effectively controlled odors, aided in fly control, reduced volume, and liquified organic waste. (Bergdoll-Michigan; Merryman, ed.)

### 2696-A6,B2,B4,C2,D2,D3

### ODOR CONTROL OF LIQUID DAIRY AND SWINE MANURE USING CHEMICAL AND BIOLOGICAL TREATMENTS,

The Pennsylvania State University, Department of Agricultural Engineering, University Park
C. A. Cole, H. D. Bartlett, D. H. Buckner, and D. E. Younkin
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 374-377.

Descriptors: Liquid wastes, Dairy industry, Chemical treatment, Biological treatment.
Identifiers: Odor control, Swine.

Dairy and swine wastes stored in liquid manure pits produce foul smells due to such components as sulfide, mercaptans, indole, skatole and ammonia. Work has nearly been completed on evaluation of chemical and biological treatment methods to eliminate these odors at the time of agitating and spreading (short-term control) or prevent their formation during storage (long-term control). Procedures were developed to measure odor levels subjectively, using an odor panel, and to measure $H_2S$ and $NH_3$ levels, using specific ion electrodes in order to evaluate the treatment methods. The chemical oxidants NaOC1, $H_20_2$, $C10_2$ and $KMnO_4$ at doses of 500 mg/l were shown to be effective for odor control of swine waste on bench scale experiments. All these oxidizing compounds reduced the $H_2S$ from levels near 100 mg/l to near or below 10 mg/l at the 500 mg/l dosage rate for waste of 5-7 per cent total solids. The most economical materials, $H_2O_2$ and $KMnO_4$, were found to cost $2.58 and $3.12 per thousand gallons of waste treated, respectively. Full scale tests on swine waste verified that they reduced odor substantially. Commercial proprietary materials utilizing enzymes, specific bacteria and disinfectants were compared with lime treatment for high pH adjustment and $NH_4NO_3$ and $NaNO_3$ treatment for oxygen supply to prevent odor formation in swine pit contents. None of the materials studied during the long-term trials, carried out in 208 liter drums over an eight-week period, significantly reduced odor of the swine manure. In addition, no noticeable reduction in $NH_3$ or $H_2S$ levels was found. Trials are currently being conducted with the commercial odor control materials and the best short-term chemicals on dairy pit contents. (Cole, et. al.-Pennsylvania State University; Merryman, ed.)

## 2697-A6, B1, F1, F4

## MANAGEMENT OF ODORS ASSOCIATED WITH LIVESTOCK PRODUCTION,

Department of Agricultural Engineering, Oregon State University, Corvallis
J. R. Miner
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 378-380.

Descriptors: Livestock, Poultry, Economics, Design.
Identifiers: Odor control.

This paper reviews and organizes existing research knowledge in livestock waste odors technology and attempts to draw from it a set of usable techniques for the concerned livestock producer or consulting engineer. Although difficult to quantify, certain practices and design choices have advantages in odor control. Among the techniques usable to minimize the potential of odor complaints are proper site selection, site modification, inhibition or modification of manure decomposition, odor making, odor absorption, and public relations. All of these techniques can be incorporated into an overall odor control program with a reasonable probability of success. The economics of odor control, unlike the economics of other livestock production costs are highly site dependent. The value of a specific site for animal feeding must be adjusted according to the anticipated cost of odor management. The chemistry of animal waste odor control suggests a use of several physical and chemical modifications to existing feedlots and confinement facilities. A combination of techniques has the potential of making odors less intense and less frequent. An analysis of livestock odor problems must include both intensity and frequency descriptions if rational decisions are to be made. (Miner-Oregon State University; Merryman, ed.)

## 2698-A6, B2, D2

## CHEMICAL TREATMENT OF LIQUID DAIRY MANURE TO REDUCE MALODORS,

Agricultural Engineering Department, Delaware University, Newark
W. F. Ritter, N. E. Collins, and R. P. Eastburn
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 381-384.

Descriptors: Chemical treatment, Liquid wastes, Dairy industry.
Identifiers: Odor control, Hydrogen peroxide, Alamask 518, Alamask 151A.

The research to be reported in the paper evaluates the effectiveness of chemical agents to control odors emanating from liquid manure. Liquid dairy manure is being treated with hydrogen peroxide and other chemicals that are available to the farmer. The chemicals are being added to liquid manure stored under anaerobic conditions in 5 and 55 gallon drums. The effectiveness of the odor control agents are evaluated by test panels on a 0 to 10 scale for presence of odor and offensiveness of the odor. Results of treating liquid manure with 6.5, 12.5, 25, 50 and 100 ppm of hydrogen peroxide show that 12.5 ppm of hydrogen peroxide suppressed hydrogen sulfide for one hour. Alamask 518 and 151A were the most effective in reducing odors in the liquid manure of the chemical agents tested to date. None of the chemical agents tested to date have completely eliminated malodors. The tests now in progress will evaluate the effectiveness of the additional compounds in controlling odors and also the loading rates required for odor control. These chemical agents will also be compared with hydrogen peroxide and Alamask 518 and 151A to determine which compound would be the most effective in controlling odors. Cost analysis for all the chemical agents tested is presented. Preliminary cost estimates on hydrogen peroxide and Alamask 518 and 151A indicate that chemical treatment is comparable or less than the cost of odor control by an oxidation ditch. (Ritter, et. al.-Delaware University)

## 2699-A8, B1, B5, E2

## LAND APPLICATION OF MANURES—WISCONSIN'S MANURE MANAGEMENT PLAN,

Extension Agricultural Engineer, Wisconsin University, 460 Henry Mall, Madison
L. R. Massie, R. D. Powell, R. E. Graves
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 385-388.

Identifiers: Waste management program, Land application, Application rates.

The production and related need to dispose of manure from a farm's livestock operation often is not compatible with the crop production schedule. A management plan has been developed to coordinate production and handling of manure with maximum utilization and minimum potential pollution. This paper describes, with examples, the manure production and utilization situation based on collectible data from each farm's records. The three major segments of data are: (1) Production of manure as related to kind, size, and number of animals, types of housing, and handling facilities, (2) Land use related to soils, conservation practices, crop rotations, acreages, and topography, and (3) Application rates of manure to the land related to kind of crop, nutrient removal by the crop, internal soil drainage, and timing of the application. Assessing the farm's manure handling situation in this way points up conflicts between livestock and crop production operations. However, these conflicts are overcome by this individualized farm plan. Each farmer can have a complete manure management program which determines the number of animals the farm can support based on the imposed limitations. Essentially, the farm has a manure management plan similar to a soil conserving or livestock production plan. Farmer acceptance was good. Farmers suggested ideas that were incorporated into the plan. Many described the plan as an assessment of the impact of their operation on the environment. (Massie-Wisconsin University; Merryman, ed.)

## 2700-A3,A4,A6,A11,A12,B2, D1,D3,E1,E2,E3,F1

## IF YOU CANNOT SPREAD IT, TREAT IT!,

Babtie Shaw and Morton, 95 Bothwell Street, Glasgow, G27HX, Scotland
P. M. Wilson
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 389-390.

Descriptors: Slurries, Waste treatment, Separation techniques, Effluent, Sludge, Aeration, Costs.
Identifiers: Land spreading, Swine.

Land spreading of pig slurry is by far the most common means of disposal in the United Kingdom as well as being the cheapest form of disposal and providing a financial saving with respect to fertilizer requirements. However, it is unlikely that this practice will be allowed to continue because of the serious organic pollution and inorganic enrichment of rivers and lakes resulting from runoff, danger of cross infection by pathogenic organisms and the ever-increasing number of complaints of smell. Thus alternative means of disposal or utilization must be found. The nature and extent of the processes required are determined by the degree of treatment needed and to some extent by the size of the piggery. A system has been recommended where an effluent of about 50 mg-litre SS and 50 mg-litre BOD (50:50 standard) could be produced. More complete treatment to a standard less than 30:20 would necessitate costly tertiary methods and unless substantial financial assistance were available these costs may be difficult to meet. The system involves separation of fibrous solids by using vibrating screens, followed by extended aeration of the liquor and final settlement. By-products of treatment include manageable, stable solids and sludges which can be spread on the land. Final effluent can be used for irrigation or washwater. Alternatively the local sewage authority may handle the final disposal step. An approximate guide to the order of cost of treatment by this scheme is given. Other treatment methods are discussed but many of these have been investigated only as far as the laboratory and pilot scale stage and insufficient information has been obtained in order to assess their performance and cost at the full scale level. (Wilson-Scotland; Merryman, ed.)

## 2701-B2,B3,C1,C2,D1,E1

## EVAPORATION OF WATER FROM HOLDING PONDS,

Professor, Department of Agricultural Engineering, North Dakota State University, Fargo
G. L. Pratt, A. W. Wieczorek, R. W. Schottman, and M. L. Buchanan
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 391-394.

Descriptors: Evaporation, Physical properties, Chemical properties, Separation techniques.
Identifiers: Holding ponds.

The potential for using evaporation ponds as a method of disposing of animal wastes has been evaluated. The goal was to develop a method for sizing ponds so all water from a waste disposal system can be disposed of by evaporation. Liquid wastes, from approximately 20 head of cattle, were drained away from the solid wastes by gravity over a concrete floor. Solids were scraped from the floor at intervals and disposed of separately. The liquid was pumped to a pond. The pond was lined with a 10 ml vinyl liner to eliminate the parameter of seepage. The flow into the pond averaged 92.1 gal/day over a 4½ month period. The evaporation rate from a floating pan was 0.3'' higher than the recorded pond evaporation. The evaporation rate from a Class "A" pan containing unpolluted water was 1.39'' higher than the pond evaporation. Generally all temperature values were similar. Various factors, such as total solids, suspended solids, volatile solids, and Biochemical Oxygen Demand of the water were measured in the laboratory. Evaporation from Class "A" evaporation pans generally has been found to run higher than from open bodies of water. Several variables, such as lake size, temperature, wind, and solar energy will influence this. A coefficient of 0.70 is commonly multiplied times the data recorded from the Class "A" evaporating pans to estimate evaporation from lakes. Experience has shown that these coefficients may range from 0.70 to 0.80. An average figure of about 0.75 is given for Fargo. Using the average evaporation figures from the tests carried out on the experimental pond from May 1 to September 15, 1973, it was found that a coefficient of 0.78 times the evaporation rate of the Class "A" evaporation pan located in Fargo gave a suitable design figure for the evaporation rate from a livestock waste disposal pond in this area. (Pratt-North Dakota State University)

**2702-B2, B4, D3, E2**

### AN ECONOMIC AND MANAGERIAL EVALUATION OF MANURE FLUMING AND LAND APPLICATION SYSTEMS,

Agricultural Marketing Manager, Gorman-Rupp Co. Box 1217, Mansfield, Ohio 44901
P. B. Bohley, C. R. Near, D. Rasmussen
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 395-397.

Descriptors: Flumes, Lagoons, Costs, Iowa, Nebraska, Design.
Identifiers: Land disposal.

The objectives of this project are to compare and evaluate the fluming, lagoon, land application system with other types of manure management programs extant. During the summer of 1974, several beef confinement lots in western Iowa and eastern Nebraska were observed and evaluated. Attention was directed towards cost of installation—including land, construction of buildings and lagoons, equipment, and personnel needed for operation. Management requirements and techniques were observed and compared. Feedlots ranged in size from 1,200-10,000 head capacity and optimum size was a factor in the evaluation of the various liquid manure systems in use. Most lots were in rural locations, only three being close to suburban areas. All confinement installations were less than three years old although most of the operators had been in business for a much longer period of time. For purposes of evaluation, these manure systems are examined by component activities, i.e. production-collection-holding-transfer-storage-land application. Systems with single and multiple flumes were observed. Building lengths varied from 500-1200 feet and lagoons, from 1½-4 acres surface area, ranged from immediately adjacent to several hundred feet distant. Sequence of flushing is based on size and number of cattle, and on climate as well. Some systems are on automatic operation and others on manual. Automatic systems are evaluated for reliability but most operators prefer manual operation. Lagoons are examined for accessibility, size, loading rate, build-up, and other pertinent factors. Two land applications systems using lagoon supply are listed in the report—one using gated pipe and the other a volume gun sprinkler. The paper appraises effluent return and the land use aspect from a mechanical and hydraulic standpoint. (Bohley-Gorman-Rupp Co.; Merryman, ed.)

**2703-B2, B4, D1, D2, D3, E2, E3, F1**

### ENERGETICS OF ALTERNATIVE WASTE MANAGEMENT SYSTEMS,

Research Assistant, Agricultural Engineering Department, Illinois University, Urbana
H. C. Kim and D. L. Day
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 398-401.

Descriptors: Recycling, Costs, Liquid wastes, Fertilizers, Anaerobic digestion, Methane.
Identifiers: Energy expense evaluations, Waste management systems, Oxidation ditch, Refeeding.

The objective of this study was to evaluate and compare major systems of livestock waste management on an energetic as well as monetary budget basis. It is a literature and computational research study using a model to simulate swine enterprises marketing 4,000 hogs per year including farrow-to-finish production facilities. The major waste management systems considered are: anaerobic storage of liquid manure using the manure as crop fertilizers; oxidation ditch treatment of liquid manure with refeeding of proteinaceous liquor; anaerobic digestion to produce methane gas and fertilizer; and drying with refeeding of dried manure. The energy expense evaluations include all man-controlled inputs such as energy in materials and equipment appropriately amortized as well as the operating energy. An energy input-output matrix developed by the University of Illinois Center for Advanced Computation is used to determine energy required for manufacturing processes. Energy credits would account for energy in utilization methods such as for fertilizer, protein, methane, etc. The analysis yields a net energy evaluation (profit or loss) for each system studied. Tentative results rank the systems as follows for energetics and monetary economics (the lowest number is assigned to the best results, etc.). All methods gave a net energy loss except for anaerobic storage and spreading on land, which gave a slight net energy profit. (1) Anaerobic storage and spreading: Btu-1; $-1. (2) Anaerobic digestion for mathane: Btu-2; $-3. (3) Oxidation ditch with refeeding: Btu-3; $-2. (4) Drying and refeeding: Btu-4; $-4. (Kim-Illinois University; Merryman, ed.)

**2704-B2, B4, C1, C2, D1, E2**

### FIELD EVALUATION OF A SETTLING CHAMBER FOR SWINE WASTES,

Extension Agricultural Engineer, Province of Manitoba
E. T. Oatway, D. D. Schulte, and L. Shwaluk
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 402-404.

Descriptors: Separation techniques, Liquid wastes, Solid wastes, Waste storage.
Identifiers: Swine, Settling chamber, Land disposal.

The swine facility studied is a 50 sow farrow-to-finish enterprise consisting of 4 units (farrow, weaners, feeders, dry sows) constructed in 1970. The units have partial slotted floors with pits 2 feet deep for the collection of wastes. Each pit is fitted with a liquid-tight gate to control the flow of wastes. Each pit is emptied by gravity flow into a main trench which conducts the wastes into two storage pits. The storage pits consist of a concrete tank and an earthen pit in series. The concrete tank functions as a settling chamber and storage for solids, and the earthen pit as a storage for liquids. The system provides a low cost method of storing swine wastes for 6 months or longer. The settling chamber requires clean out every six months. The earthen liquid pit can be emptied by pump and irrigation or tank wagon. Total and suspended solids, total and ammonia nitrogen, and phosphorus data has been collected and used to study the effectiveness of the pit arrangement as a solids separation method. (Oatway-Canada)

**2705-A11, A12, B1, D3, E3, F1**

### LIVESTOCK AGRICULTURE IN THE STATE OF HAWAII–A REGIONAL APPROACH TO WASTE MANAGEMENT,

Department of Agricultural Engineering, College of Tropical Agriculture, Hawaii University, Honolulu
G. M Wong-Chong, W. I. Hugh, J. H. Koshi, T. Tanaka, C. Schlottfeldt
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 405-407.

Descriptors: Hawaii, Economics, Farm management.
Identifiers: Regional Wastes Management, Composting.

Livestock agriculture in the State of Hawaii is influenced by several factors: (a) importation of almost all feed stuffs from mainland, (b) concentration of the state's population (about 75 per cent) in Honolulu, (c) high cost of inter-island transportation, and (d) increasing urban development encroaching on agricultural land. Because of the population density in Honolulu, a major fraction of the livestock agriculture is on Oahu; in fact, some 50-70 per cent of the State's livestock activities is in the Waianae-Mikilua-Lualualei (3500 acres) area. Unfortunately, this area is presently experiencing increasing pressures from urban developers and the resulting demands for more rigid wastes management. The farms in the parcels of land (2-15 acres). In many cases land disposal of wastes is not an effective alternative and other treatment processes are too expensive. In the Waianae-Mikilua-Lualualei area, the feasibility of a regional wastes management scheme was examined. This regional approach was to collect all the animal wastes at a centralized composting site. The paper discusses (a) The waste collection system. (b) The composting process alternatives—windrow vs. forced aeration. (c) The market potential for compost in the State. (d) The economics of the proposed system. (e) The problems of disease transmission control. (f) The institutional problems of getting such a scheme to work. (Wong-Chong—Hawaii University)

**2706-A2, B2, B4, C2, F2, F6**

### ESTIMATING QUANTITY AND QUALITY OF RUNOFF FROM EASTERN BEEF BARNLOTS,

Soil Scientist and Statistician, North Appalachian Experimental Watershed, USDA, ARS, NCR, Coshocton, Ohio
W. M. Edwards and J. L. McGuinness
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 408-411.

Descriptors: Agricultural runoff, Feedlots, Cattle, Ohio.
Identifiers: Prediction equation, Runoff quantity, Runoff quality.

Proposed EPA guidelines for feedlot effluent require that by 1983 all feedlot operations have the capacity to store runoff from 25-year, 24-hour rainfall. In view of these requirements, an analysis was made of runoff volume and quality from a typical unpaved beef barnlot in eastern Ohio. The measurements were made over a 4-year period on a 0.4 acre, 60 head barnlot watershed at the North Appalachian Experimental Watershed, Coshocton, Ohio. A prediction equation for daily runoff volume was developed by a multiple regression analysis of 181 runoff events. Rainfall amount and antecedent moisture content of the surface layer accounted for 75 per cent of the storm runoff variability. Joint probabilities of various amounts of rainfall occurring with different antecedent soil moisture conditions were used to define maximum, minimum and mean daily runoff volumes at different times of the year. Inclusion of a rainfall intensity variable in the multiple regression did not improve the runoff volume prediction. The presence or absence of cattle in the lot at the time of the event also had no effect upon prediction of runoff volume. The seasonal distribution of N, P, K and BOD concentrations in runoff were determined. Using long-term weather records, water quality data, and the runoff prediction equation, runoff volume and associated nutrient transport for 10- and 25-year frequency storms occurring at different times of the year were also estimated. The rainfall prediction was also used to extend runoff relations to paved lots. (Edwards and McGuinness-USDA)

### 2707-A8, B4, E2, E6

### A COMPUTER SIMULATION OF STORAGE AND LAND DISPOSAL OF SWINE WASTE,

Department of Agricultural Engineering, Arkansas University, Fayetteville
C. R. Mote and E. P. Taiganides
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 412-415.

Descriptors: Waste storage, Waste disposal, Performance.
Identifiers: Swine, Computer simulation, Land disposal, Cropping systems.

Crop production cycles, soil trafficability conditions, and variations in the animal population determine the performance of storage and land disposal systems for wastes from confinement swine production units. A computer simulation program was developed which simulates these factors and their interactions. Studies made with the program indicate that: (1) a given capacity storage tank can provide storage capacity for more of the waste produced over a period of time if emptying operations are initiated well before the tank is completely full, (2) the types of crops being grown on the land available for waste disposal affect the storage capacity required to prevent overflow, and (3) the net annual cost of waste storage and land disposal systems may be reduced by modifying the cropping pattern for a given acreage. A total of 63 different waste storage and land disposal situations was studied with the computer simulation program. The study included combinations of seven storage capacities, three cropping programs, and three criteria for initiating the removal of waste from storage. For each of the 63 different conditions the behavior of the system was simulated for a five-year operating period. The performance of the system for each of the 63 five-year operating periods was compared in order to observe the effect of variations in storage capacity, cropping program, and hauling initiation criteria. (Mote and Taiganides-Arkansas and Ohio; Merryman, ed.)

### 2708-A2, B2, E2, F6

### MANAGEMENT OF IRRIGATION FOR DISPOSAL OF FEEDLOT RUNOFF IN COLD CLIMATES,

Assistant Professor, North Dakota State University, Fargo
R. W. Schottman, C. W. Thoreson and J. K. Koelliker
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 416-420.

Descriptors: Irrigation, Agricultural runoff, Feedlots, North Dakota, Model studies, Design, Climates, Pumping.
Identifiers: Detention pond.

Management of the pumping of livestock runoff to be used for irrigation is considered for several locations in North Dakota. Pumping durations, pumping rates and detention pond size and shape are simulated for stations having contrasting climatological conditions. Runoff events are predicted and are compared to the 10-year and 25-year, 24 hour storms for each station. All stations are characterized by at least a 90 day period of continuously frozen conditions and by a growing season of approximately 120-130 days. Runoff is predicted using a model similar to that developed by Larson at the University of Minnesota. The model has been expanded to allow specification of pumping rates and duration as well as pond size and shape. At least 30 years of daily precipitation and temperature records were used as input data for each station. The SCS runoff model is used as the basis for predicting the size of each runoff event. Runoff and pumping programs for two commercial feedlot operations were monitored and the observed water levels and runoff events were compared with predicted values. Design recommendations are proposed for the rather unique climatological conditions encountered in North Dakota. The model's applicability to other climatological conditions is also demonstrated. (Schottman, et. al.-North Dakota and Kansas)

### 2709-A2, B2

### RUNOFF CONTROL FACILITIES FOR BEEF CATTLE FEEDLOTS IN EASTERN NEBRASKA,

Agricultural Engineering Department, University of Nebraska
J. A. Nienaber, C. B. Gilbertson, T. E. Bond, and J. L. Gartung
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 421-425.

Descriptors: Agricultural runoff, Feedlots, Cattle, Nebraska, Research and development, Design, Performance.
Identifiers: Runoff control.

This paper is a final report of five years research on feedlot runoff control facilities on eight Eastern Nebraska research, and cooperator sites. Runoff quantity and quality, solids transported and solids removal efficiencies are discussed in terms of system design, performance, and management. Research demonstration site for a 4000 head feedlot was installed in 1973 based on the 5 year results. The design of this EPA sponsored project will also be reported. (Nienaber, et. al.-Nebraska University)

### 2710-A2, B2, F1, F6

### DESIGN RUNOFF VOLUME FROM FEEDLOTS IN THE SOUTHWESTERN GREAT PLAINS,

Agricultural Engineer, USDA, ARS, Water Quality, Management Laboratory, Route 2, Box 322A, Durant, Oklahoma.
V. L. Hauser
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 426-428.

Descriptors: Design, Agricultural runoff, Feedlots, Texas, Economics.
Identifiers: Southwestern Great Plains, Runoff control, Soil Conservation Service runoff equation.

The design of feedlot pollution control systems required an estimate of the runoff volume to be controlled. Federal and State regulations presently rely on the Soil Conservation Service (SCS) equation for runoff estimation. They also rely on the Weather Bureau Technical Publication No. 40 (TP 40) for estimates of the design storm, which, in Texas, is 24-hour rainfall expected once in 25 years. This paper examines the accuracy of these present design procedures. A recently published equation for runoff derived from runoff measurements on a feedlot at Bushland, Texas (near Amarillo) was tested against the more widely used SCS equation. Runoff was computed by each equation for each day with rain in a 35-year rainfall record from Bushland and in an 82-year rainfall record for Amarillo. These computed runoff amounts were analyzed to derive return frequency of runoff amount for the new Bushland equation and for the SCS equation. The results show that the presently used design method may compute up to 3 times as much runoff as the new Bushland equation. In addition, significant differences were found between 24-hour, 25-year return frequency rainfall found in TP 40 and the actual record from the two stations analyzed. Over estimation of the design runoff amount from feedlots causes wasteful expenditure in both runoff reservoir construction and the purchase of a disposal system. This research indicates the need for revision of design methods and requirements of law. (Hauser-Oklahoma; Merryman, ed.)

### 2711-A2, C2

### QUANTITY AND QUALITY OF BEEF FEEDYARD RUNOFF IN THE GREAT PLAINS,

Agricultural Engineer, ARS, USDA, Southwestern Great Plains Research Center, Bushland, Texas
R. N. Clark, C. B. Gilbertson and H. R. Duke
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 429-431.

Descriptors: Agricultural runoff, Cattle, Great Plains.
Identifiers: Runoff quantity, Runoff quality.

The Great Plains Region has become the world's largest confined cattle feeding area during the last 10 years. The region increased fed cattle production from 6 million in 1963 to over 14 million in 1973. Also, during the last decade, water quality control regulations have been established requiring the impoundment of runoff and waste water from these feedyards. Runoff studies were begun about 1967 at several locations throughout the Great Plains in order to characterize feedyard runoff as to quantity and quality. The objective of this paper is to combine these data and present them in a uniform format. Rainfall-runoff relationships are presented from seven feedyards from eastern Nebraska and eastern Colorado to South Texas. In all cases, the rainfall-runoff relationship was linear; however, the slopes varied from 0.36 to 0.86. Runoff did not begin until at least 1 cm (0.4 inch) of rainfall had occurred. The quality of runoff was quite variable at each location depending on rainfall intensity and duration, time since last runoff, and stocking rate. However, noticeable differences were found between the various research locations. The concentration of salts was less in eastern Nebraska and increased inversely with total rainfall to highest concentration in West Texas. (Clark, et. al.-Texas, Nebraska, and Colorado)

### 2712-A2,A10,B2,B3,B4,C1, C2,D1,E2

### PROPERTIES OF SOLIDS FROM STACKED MANURE,

Assistant Professor, Department of Agricultural Engineering, Wisconsin University, Madison
J. C. Converse, C. O. Cramer, G. H. Tenpas, and D. A. Schlough
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 432-436.

Descriptors: Solid wastes, Liquid wastes, Separation techniques, Waste storage, Chemical properties, Physical properties, Land application.
Identifiers: Manure stacking, Detention ponds, Fly control.

Over winter storage of manure is receiving much emphasis because of concern for environmental quality and desire of the livestock operator to reduce drudgery of daily hauling. Stacking manure is most appropriate for stanchion type dairy facilities. This paper summarizes three years of data from three different stacking systems. The three systems include a covered bunker type storage for 32 cows, a platform type storage with swinging slide elevator for 28 cows and a platform type storage with a manure blower for 26 cows. Separation of liquids from solids was used in all three systems using drains and porous media. Liquids were stored in a detention pond for later application to crop land. Stacking was done year around with removal during spring and fall. Each system was evaluated for both winter and summer periods for solid and liquid volumes, physical and chemical characteristics of solids and liquids, stackability of manure and fly problems. Liquid runoff from stacks has high pollution potential and must be kept out of bodies of water. Liquid volumes varied with rainfall, amount of manure in storage and ability of liquid to separate from solids. A porous media is required between the manure and concrete floor of storage unit. Solid storage volume requirements were about 1.6 cu. ft.-1000 lb. of live weight. Chemical fly control is ineffective and uneconomical for summertime stacking, but biological fly control is effective and economical. Stackability is dependent upon quantity of straw used and time of year stored, with wintertime stacking superior to summertime stacking. This information will provide the design engineer with tools to adequately design solid manure storage facilities. (Converse-Wisconsin University)

## 2713-A6,A7,B2,C1,C2,D3,E3

### MANAGEMENT OF A FLUSHING-GUTTER MANURE-REMOVAL SYSTEM TO IMPROVE ATMOSPHERIC QUALITY IN HOUSING FOR LAYING HENS,

Department of Agricultural Engineering, Iowa State University, Ames
R. L. Fehr, and R. J. Smith
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 437-440.

Descriptors: Waste water treatment, Lagoons, Recycling, Poultry, Air pollution.
Identifiers: Air quality.

An 1100-bird layer house at Iowa State University has been remodeled by installing a flushing-gutter manure-removal system. There are three ranks of cages in the building with sloping metal trays under the outer ranks of cages and a central wastewater holding pit. Wastewater is pumped from holding pit to dosing-syphon tanks for flushing metal trays. Wastewater in the central holding pit is periodically pumped 2000 ft. (610 m) to an anaerobic lagoon. Overflow from the anaerobic lagoon enters an aerobic lagoon; liquid from this second lagoon is recycled to the central holding pit. Because frequent manure removal aids in odor control, ammonia and hydrogen-sulfide-gas levels are being monitored to determine optimum system management. The management consists of varying the interval between emptying of the central holding pit, and varying the interval between the flushings of the metal trays. With reduced odor levels in the house, it is feasible to reduce ventilation rates. Winter ventilation rates are being lowered below the recommended 1/2 cfm to 1/8/1/4 cfm (p.014 m$^3$-min to 0.0035-0.007m$^3$-min) per bird. Temperature, humidity and dust levels are also being recorded at various points in the house. Wastewater pumped to the lagoons and recycled is being monitored to determine the effectiveness of the treatment system. COD, total solids, dissolved solids, and ammonia-nitrogen levels are being measured. These measurements are also being made on wastewater in the house to determine interaction between these parameters and atmospheric environment. Success of the system is related both to improved environmental control around the birds and to mechanization of manure handling. (Fehr-Iowa State University)

## 2714-B3, C1, E2, F4

### PERFORMANCE OF SCREW CONVEYORS FOR UNLOADING SLUDGES FROM FIELD TRANSPORTS,

Biological and Agricultural Engineering Department, Rutgers-The State University of New Jersey, New Brunswick
M. Weil and A. Higgins
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 441-443.

Descriptors: Equipment, Performance, Economics.
Identifiers: Land disposal, Screw conveyors, Field transports.

Equipment has been developed to incorporate a wide range of biodegradable wastes directly into the upper 8 inches of the soil by Plow-Furrow-Cover, Sub-Sod-Injection, and Ridge and Furrow. Physical properties of wastes unloaded from this equipment may vary from thin slurries to caked materials with up to 75 per cent solids (wet basis). There are economic advantages to handling materials with a solids content of 15 per cent or greater. A field transport for such material must be water tight and readily unload sludge with a wide range of physical properties. A review of literature indicates the difficulty of describing the physical properties of sewage sludges. Per cent solids does not adequately indicate the handling characteristics of this material. Field tests of equipment have shown that screw conveyors are well suited for unloading sludges from field transports. Very little has been published about actual performance of screw conveyors for conveying sewage sludge. Extensive tests using sewage sludges with varying physical properties were made on 9-inch-diameter helicoid flight and 9-inch-diameter ribbon flight screw conveyors. Mass flow rate and horsepower requirements were determined with varied screw conveyor slope and rotational speed. Less extensive performance tests were conducted on 6-inch-diameter helicoid flight and 12-inch-diameter ribbon flight screw conveyors. The performance data collected were compared to handbook performance data. (Weil-Rutgers)

## 2715-B1, C1, E2

### EQUIPMENT FOR INCORPORATING ANIMAL MANURES AND SEWAGE SLUDGES INTO THE SOIL,

Professor of Agricultural Engineering, Biological and Agricultural Engineering Department, Rutgers State University, New Brunswick, New Jersey
C. H. Reed
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 444-445.

Descriptors: Equipment, Animal wastes, Sludges, Physical properties.
Identifiers: Land disposal, Plow-Furrow-Cover, Sub-Sod-Injection, Ridge and Furrow.

Soil, land, and environment can be improved when biodegradable wastes are recycled by incorporation directly into the aerobic layer of the soil. During the last 9 years, equipment has been designed, assembled, or adapted from commercially available components, and field tested. Techniques for incorporating animal wastes and sewage sludges directly into the soil in one or two passes over the ground are Plow-Furrow-Cover, Sub-Sod-Injection, and Ridge and Furrow. The physical properties of these wastes have varied from thin slurries of animal manures and septic tank pumpouts (2 per cent solids), to to semisolid sludges (15 to 25 per cent solids), animal manure with bedding; and sand-bed-dried sewage cake with up to 75 per cent solids, which is the most difficult of all to unload. The equipment has incorporated up to 200 tons per acre at a ground speed of 3 mph. Two types of trailer chassis have been developed to be used with a standard 50 hp farm tractor. The first has a gooseneck tongue which provides space for mounting the plow, injector or ridge-and-furrow opener on the 3-point-hitch of the tractor. The most recently developed unit has these components mounted on the trailer chassis. Preliminary field testing of this unit has indicated some advantages over the excellent performance of the chassis with the gooseneck tongue. As a result of extensive field testing, a water-tight tank with appropriate accessories has been designed and is being assembled. This equipment is designed to unload any of the aforementioned materials at a minimum rate of 60 cfm. This tank may be either trailer or truck mounted. (Reed-Rutgers)

## 2716-B1, F1, F6

### SHORTEST PATH NETWORK ANALYSIS OF MANURE HANDLING SYSTEMS TO DETERMINE LEAST COST–DAIRY AND SWINE,

Department of Agricultural Engineering, McGill University, Ste. Anne de Bellevue, Quebec H9X 3M1, Canada
J. R. Ogilvie, P.A. Phillips and K. W. Lievers
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 446-451.

Descriptors: Structures, Swine, Dairy industry.
Identifiers: Canada, Network analysis techniques, Costs, Equipment.

Network analysis techniques were used to assess alternatives in manure management systems. The shortest path network analysis (SPNA) was adopted. This modification of CPM and PERT techniques yields the least cost when the duractions of activities are expressed as capital, operating or energy costs. The objective was to evaluate certain existing practices to determine least cost to the farmer using SPNA. Equipment and structures for manure handling, comprising 250-300 elements (such as gutter cleaners, tractor loaders, manure tanks and tankers) were analyzed and data is presented in graphical and tabular form. These results show least cost among the various complete systems utilizing these components for particular conditions and scale of operations. The components for dairy cattle are based on the elements found in the plans recommended for the Canada Plan Service. Most cost inputs were obtained by field observations. Similarly swine systems are based on existing Plan Service recommendations but various processing systems have also been included. (Ogilvie-McGill University)

## 2717-B1, D1, D3

### APPLICATION OF THE ROTATING FLIGHTED CYLINDER TO LIVESTOCK WASTE MANAGEMENT,

Department of Agricultural Engineering, Oregon State University, Corvallis
J. R. Miner and W. E. Verley
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 452-455.

Descriptors: Biological treatment, Livestock, Separation techniques, Aeration, Sedimentation, Slurries, Dairy industry.
Identifiers: Rotating flighted cylinder, Swine, Oxygen transfer.

A solid-liquid separator has been devised which utilizes sedimentation in a unique physical arrangement. The device consists of a tube mounted on a slight incline. On the interior surface of the tube, a spiral fin, similar to a deep screw thread, is attached, forming a series of small sedimentation basins within the tube. Solid-bearing water is introduced into the tube approximately one-third the tube length from the upper end. As the water flows over the fin and through the sedimentation basins, settleable solids are deposited. As the tube is slowly rotated, the solid fraction is transported out the upper end. The nature of the solid stream depends upon the design of the upper wraps of the fin. In addition to solid-liquid separation, the fin on this device performs an aeration and biological treatment function similar to the disks of a rotating biological contactor. Oxygen transfer rates for the rotating flighted cylinder have been measured and are a function of flow rate and rotational speed. In this paper, operating data are included for the separation of solids from both swine and dairy manure slurries using 8 and 24 inch diameter metal tubes. Oxygen transfer studies were conducted using an 8 inch diameter tube of PVC plastic with fiberglass fins.

Data are also provided from biological waste treatment studies using this latter tube treating a dairy manure slurry. (Miner and Verley-Oregon and Kansas)

## 2718-B2, C1, C2, D1, D3
### SETTLING CHARACTERISTICS OF SWINE MANURES AS RELATED TO DIGESTER LOADING,

North Central Region, Agricultural Research Service, USDA, Columbia, Missouri
J. R. Fischer, D. M. Sievers, and C. D. Fulhage
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 456-458.

Descriptors: Separation techniques, Anaerobic digestion, Phosphorus, Potassium, Slurries, Nitrogen, Sedimentation, Design.
Identifiers: Settling characteristics, Swine, Gutter-flush system.

Loading of an anaerobic digester is critical for its successful operation. When a gutter-flush system is used to collect swine waste, much of the flush water must be wasted and the solids concentrated before allowing the waste slurry to enter the digester. One of the simplest and most economical means of concentrating solids is sedimentation. For proper digester loading, it is desirable to know the fraction of removal of volatile solids, organic nitrogen and total solids that can be achieved by settling. From a potential fertilizer value, it is desirable to know the fraction of phosphorus and potassium. A 3 x 4 x 4 factorial in a split-split plot design with 3 replications was utilized using a 6-foot deep, 5½" ID settling chamber. Slurries of .05, .5 and 5 per cent solids were used. Samples were taken at 1, 10, 100 and 1000 minutes and analyzed for total solids, volatile solids, organic nitrogen, total phosphorus and potassium. Samples were taken at depths of 0, 2, 4 and 6 foot from the top of the settling chamber. After one hour of settling at the 6-foot depth, 40 per cent of the total solids were removed for the .5 per cent solid slurry and 29 per cent of the total solids removed for the .05 per cent slurry. The thicker slurries exhibited better settling. An average total phosphorus removal of 47 per cent and 32 per cent at 100 minutes was achieved for the .05 and .5 per cent slurries respectively. For the .05 per cent slurry, an average removal of organic nitrogen for the 0, 2 and 4-foot depths at 100 and 1000 minutes was 32 and 44 per cent respectively. Little settling of organic nitrogen occurred after 100 minutes for all slurries. Potassium being largely dissolved was not readily removed from the slurry. Less than 5 per cent removal was achieved at any depth for the 1000 minute time period. (Fischer, et. al.-Missouri; Merryman, ed.)

## 2719-B2, B3, D1, D3, E3
### A ROTATING CONICAL SCREEN SEPARATOR FOR LIQUID-SOLID SEPARATION OF BEEF WASTES,

Department of Agricultural Engineering, Oklahoma State University, Stillwater
R. Shirley and A. Butchbaker
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 459-462.

Descriptors: Separation techniques, Design, Slurries, Cattle.
Identifiers: Rotating conical screen separator, Liquid-solid separation, Refeeding, Oxidation ditch.

The objective of this research was to remove the undigestible and coarse material from aerated beef waste slurries. Removal of hair and undigested corn particles was desired in order to improve the pumpability of the slurry and to concentrate the finer and more protein rich particles into one medium for refeeding studies. A rotating conical screen separator was designed, constructed, and tested. The separator had a conical screen sloped at a 45 degree angle below the horizontal. The screen was rotated about a vertical axis at a low RPM. Influent from an oxidation ditch was introduced at the top of the screen. The course solids remained on the screen and slid down the screen until slung off by centrifugal forces. The liquid fraction penetrated the screen and was collected by a funnel attached to the screen. The screen mesh had an opening of 0.10 inches and screened about 10.37 per cent of the solids (mainly hair and coarse grain particles). The collected slurry was rich in protein matter and very pumpable. The theoretical maximum power required at a flow rate of 142 lb-min (64.5 kg-min) was 0.4 watts. A peripheral screen speed of 168 ft-min (51 m-min) gave optimum separation of the waste. (Shirley and Butchbaker-Oklahoma State University)

## 2720-B2, B3, C1, C2, D1
### EVALUATION OF SOLIDS SEPARATION DEVICES,

The Ohio Agricultural Research and Development Center, Wooster, Ohio
J. W. Shutt, R. K. White, E. P. Taiganides and C. R. Mote
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 463-467.

Descriptors: Separation techniques, Screens, Settling tanks, Chemical oxygen demand, Biochemical oxygen demand.
Identifiers: Liquid cyclone, Solids removal, Total solids, Total volatile solids, Total suspended solids.

Stationary and vibrating screens, a liquid cyclone, a circular settling tank, and laboratory scale devices were evaluated for their efficiency of solids removal from a stream of untreated and treated wastewater. Separation efficiencies were measured by changes in total volume, TS, TVS, TSS, BOD, and COD. For the stationary screen, two different screen opening sizes (0.040 and 0.060 inch sieves) were tested under four different flow application rates ranging from 26 to 89 gpm. Four screen size openings (0.0047, 0.0065, 0.0084, and 0.0153 inches) and three application rates (range: 9-30 gpm) were used in the tests run with a vibrating screen. Results indicate that for each screen size there is an optimum application rate. A 3-inch diameter liquid cyclone with three different underflow nozzle diameters (0.125, 0.188 and 0.250 inch) was tested at four different pressure drops (20, 40, 60, and 80 psi). The tests show there is an optimum pressure drop at which the liquid cyclone should be operated. The liquid cyclone accomplished an 18 fold increase in TSS concentration of solids in the influent wastewater stream. Removal efficiencies of TSS, COD, and other parameters with settling tanks are affected by detention time, overflow rate, suspended solids concentration in wastewater, and degree of pretreatment. Both field installations and laboratory models were studied. Suspended solids removal of over 90 per cent were consistently achieved with COD removal in the range of 60 per cent. Solids removal from wastewater streams with TSS of 2-4 per cent occurs as a zone settling process. As the initial TSS concentration in the wastewater stream increased, unit area needed for settling also increased. (Shutt, et. al.-Ohio; Merryman, ed.)

## 2721-B3, B5, C1, D1, D2
### IN-HOUSE HANDLING AND DEHYDRATION OF POULTRY MANURE FROM A CAGED LAYER OPERATION: A PROJECT REVIEW,

Department of Agricultural Engineering, Michigan State University, East Lansing
M. L. Esmay, C. J. Flegal, J. B. Gerrish, J. E. Dixon, C. C. Sheppard, H. C. Zindel, and T. S. Chang
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 468-472.

Descriptors: Poultry, Dehydration.
Identifiers: Flash-type dryer.

A manure drying system involving caged layers with daily manure collection, air drying and final dehydration in a flash-type dryer has been studied at Michigan State University. The system was a commercial-type poultry building with four rows of wire, triple deck, cages, 21.95 meters (72') long with dropping boards for the top two decks. The cages were 30.48 cm by 40.64 cm (12" x 16"). One-half of the cages contained four birds per cage. This resulted in a startling flock of 5,292 birds. Droppings from the upper two cage rows were hand scraped daily to the pit below the bottom cage row. A cable-blade scraper removed these droppings onto a continuous conveyor belt in a drying tunnel. Droppings remained on the belt approximately twenth-four hours. Then the droppings were conveyed into a flash-type dryer. Drying took place on dropping boards, in the tunnel, and in the flash-type dryer. Drying on the dropping boards can reduce the moisture content of the manure to 65 per cent (W.B.) or less. After drying in the tunnel, moisture content can be reduced to 50 per cent (W.B.) or less. Outside weather conditions influence drying. The above figures are for summer conditions. For winter conditions, respective values of 72 per cent and 70 per cent are more representative. Spillage from waterers, etc. can also influence these figures. The ventilating air of a poultry house can be used to remove moisture from manure. In-house drying removes the largest portion of water. Drying from a belt in a tunnel is very effective under summer conditions. (Esmay-Michigan State University; Merryman, ed.)

## 2722-B3, D2, E3
### DRYING OF POULTRY MANURE–AN ECONOMIC AND TECHNICAL FEASIBILITY STUDY,

Unilever Research Laboratory, Port Sunlight, Wirral, Merseyside, L62, 4XN, UK
J. B. Akers, B. T. Harrison, and J. M. Mather
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 473-477.

Descriptors: Economics, Equipment, Poultry, Feasibility studies, Fertilizers.
Identifiers: Dried poultry manure, Refeeding.

The current United Kingdom interest in dried poultry manure originates from: (1) Shortage of protein in desirable meat form, (2) Realisation of the developing animal feedstuffs possibilities of poultry manure in the light of inflating prices of conventional animal feedstuffs, (3) Developing potential of poultry waste as a fertilizer in view of the recent and continuing escalations in compound fertilizer psices, and (4) Continuing development of intense husbandry of poultry and the concomitant waste disposal problem. A detailed analysis of the various types of dryer suitable for manure is presented. Pneumatic conveying, rotary drum and batch agitated driers were considered technically most suitable and possible improvements suggested. Costings are presented on a realistic basis, i.e. current costs, which include cost of capital for equipment and installation, maintenance, depreciation and labour. Costings show the economic advantages acruing from large scale operation and illustrate when small scale driers can become economically viable. Results are presented for scales of operation between 10-4 and 10-6 layers. Further costings are presented for manure which has been dewatered before drying. Both fuel oil and natural gas have been considered as fuels, and also the effects of variation in fuel costs. An assessment has been made of the suitability of different drying schemes to various applications and farming situations. (Akers, et. al.-United Kingdom)

2723-B3, D1, F1, F6

### DRYING DAIRY WASTES WITH SOLAR ENERGY,

Department of Agricultural Engineering, California University, Davis
B. Horsfield
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 478-480.

Descriptors: Drying, Costs, Composting, Recycling.
Identifiers: Dairy wastes, Solar energy.

The author has previously carried out a computer simulation study to determine the feasibility of using solar energy on a year around basis to dehydrate animal wastes. The objective of this experiment was to verify those computer simulation results. The experimental procedure consisted of loading, at regular intervals, two small plastic greenhouses with fresh dairy wastes. The loading rates, i.e., pounds of wet manure per square foot per day, were established from experience gained with the computer simulation studies. The wet manure was placed in the greenhouses and carefully mixed in with the partially dried contents in an attempt to create a homogenous material. In addition to mixing in the wet material, the entire contents of each greenhouse was thoroughly mixed on an approximately weekly basis to insure that the contents remained in an aerobic condition. The wet manure was weighed and sampled for moisture content at the time of loading and the contents of the greenhouses were periodically sampled to determine moisture content. In addition, temperatures of the drying mass were periodically recorded because they provided an indice of aerobic activity. The results indicate that the partially dried dairy wastes can maintain thermophilic temperatures for prolonged periods and that composting contributes to dry matter loss as well as energy for evaporation. A comparison of the recorded solar energy input was made to the amount of moisture loss in order to determine the efficiency of the solar collecting apparatus. The results indicate that such a solar drying procedure is feasible if a mechanism is available for thoroughly mixing the wet manure with the contents and for maintaining aerobic conditions. A projection is made of the capitol investment and operating costs required for such a concept to be applied to a typical dairy operation. (Horsfield-California University; Merryman, ed.)

2724-D3, F6

### HIGH-RATE MECHANIZED COMPOSTING OF DAIRY MANURE,

Department of Agricultural Engineering, Maryland University, College Park
J. W. Hummel and G. B. Willson
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 481-484.

Descriptors: Design, Model studies.
Identifiers: Composting, Dairy manure.

Research was initiated to investigate mechanized aerobic composting. Research objectives were: (1) to design and develop an alternative method for reduction and/or utilization of livestock production wastes, (2) to investigate the applicability of this method to particular livestock production units for the control of air and water pollution, and (3) to develop and investigate alternative uses for these "wastes." Based upon the laboratory study of this concept, a pilotscale mechanized composting system has been designed and placed in operation at the University of Maryland Dairy Barns on the College Park Campus. Wastes (bedding, urine, and feces) from the 80-cow milking herd housed in stanchion barns are transferred by conveyor to the compost system on a daily schedule. The compost channel is sized to accept and retain these wastes for a 15-day period. During this time, the wastes are aerated continuously and stirred daily by an elevating mechanism which traverses the length of the channel. Each traverse of the elevating mechanism moves the wastes an increment of the channel length, resulting in a semi-continuous flow system. Thus, the channel is charged with raw wastes at one end, and the partially composted material is removed at the other end and moved to a programmed windrow to complete composting using natural convective aeration. Operational problems encountered and modifications made to the system during a 1.5-year operating period are discussed. Results obtained with this pilot system led to the conclusion that the wastes are reduced and more readily handled and utilized. (Hummel-Maryland University; Merryman, ed.)

2725-B3,B4,C1,C2,D1,D3

### AEROBIC COMPOSTING--NEW BUILT-UP BED TECHINQUE,

Department of Agricultural Engineering, Ohio State University, Columbus
D. P. Stombaugh and R. K. White
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes—1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 485-489.

Descriptors: Aerobic conditions, Equipment, Design, Performance.
Identifiers: Composting, Swine.

A new aerobic composting system has been constructed and evaluated using swine waste. The built-up bed, aerobic composter provides both treatment and storage capability and should be adaptable to other animal wastes. The upper layers (top 30 to 40 cm) of the waste material stored in a large bin are tilled, mixed and leveled to provide uniform conditions and an adequate oxygen supply for rapid aerobic composting. With daily addition of 3 cm of waste over the bin surface, the waste undergoing most rapid composting is located in the upper 30 cm, while partially stabilized compost is allowed to ripen beneath the layers being tilled and is not aerated. Observations of machine and composter performance indicated that the tillage device as designed adequately mixes, aerates and levels in one or two passes (depending on the frequency of tilling) without clogging. Once a manure depth of 20 to 30 cm was obtained in the compost bin, process temperatures of 50 to 70 degrees C were rapidly developed and maintained. With appropriate limits placed on loading rates, type and condition of manure and duration, frequency and depth of tilling, satisfactory composting rates were maintained. Large decreases in moisture content and volatile solids, as well as pH measurement, C:N ratios, and observations of odors and compost appearance indicated that this new technique provides an alternative method for treating and storing solid livestock waste. (Stombaugh-Ohio State University; Merryman, ed.)

2726-A6,B3,B5,C1,C2,D3

### CONSERVATION OF NITROGEN IN DAIRY MANURE DURING COMPOSTING,

Agricultural Engineer, ARS-USDA, College Park, Maryland
G. B. Willson and J. W. Hummel
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 490-491.

Descriptors: Nitrogen, Dairy industry.
Identifiers: Composting.

Composting has been shown to eliminate undesirable odors, kill week seeds, and improve handling characteristics for dairy manure. However, nitrogen can be lost during composting. This research was conducted to determine the potential for nitrogen conservation through process control. A bulking material must be added to fresh manure to develop porosity for air movement and rapid aerobic thermophilic composting. Different levels of sawdust, straw, perlite and compost were added as bulking materials. Results are reported on 18 tests in bins with a capacity of 30 cubic feet and 52 tests in bench digestors with a capacity of one-third cubic foot. Spot checks were made in a pilot composter, composting the manure from an 80 cow dairy herd to verify laboratory results. The effect of type and quantity of bulking material on aeration and on loss of nitrogen will be discussed. Other properties that will be reported include, ammonia, nitrate, chemical oxygen demand, volatile solids and pH. The composting process can be managed to conserve nitrogen in dairy manure. Due to the reduction in volatile solids during processing the nitrogen concentration may be greater in compost than in raw manure. (Willson-USDA; Merryman, ed.)

2727-B3, D3,

### COMPOSTING SWINE WASTE,

Department of Biological and Agricultural Engineering, Rutgers State University, New Brunswick, New Jersey
M. E. Singley, M. Decker, and S. J. Toth
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 492-496.

Descriptors: Yields.
Identifiers: Composting, Swine, Windrow technique, Bulking material.

Early tests of composting of swine waste using the windrow technique demonstrated that swine waste is a dense material that excludes air resulting in a lengthy composting time. After turning a windrow with the Roto-Spreader, a commercial composting machine, the incorporated oxygen disappeared in an hour or less. To reduce bulk density and allow air movement in the waste, a bulking material was added. In eleven windrow tests using different compositions of bulking materials and dense wastes, composting time was reduced significantly. The bulking material was either street refuse delivered by compactor truck or discard material collected from a shaker separator. Average composting time to reach temperature decline and suitable granulation for shaker separation for the last seven windrows was four weeks and four days. Windrows requiring the shortest time, three weeks and five days, were composed of approximately 75 per cent swine waste and 25 per cent street refuse by volume. A windrow of 50 per cent swine waste and 50 per cent bulking material collected from the shaker separator required six weeks. Windrows were turned twice daily on week days using the Roto-Shredder for an average total of 45 times. No separation of non-biodegradable material was made prior to composting. During turning, the glass was broken into fine pieces, the metals hammered into compact shapes, and the plastic shredded. As a result, the usable compost was easily separated from the material to be discarded. The yield was roughly 50 per cent compost with a high inert material content and 50 per cent discard. (Singley-Rutgers)

2728-B2, C3, D3, F1

### LIQUID COMPOSTING OF DAIRY MANURE,

James M. Montgomery, Consulting Engineers, Inc., 555 East Walnut Street, Pasadena, California
F. A. Grant
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 497-500.

Descriptors: Liquid wastes, Dairy industry, California, Equipment, Costs.
Identifiers: Composting.

The Santa Ana River basin of California has a total dairy cow population of approximately 174,000. Most of these cows are confined to a relatively small portion of the basin in the vicinity of Chino and Corona where the wastes from these cows burden the basin groundwater resources. The dairies are confronted with discharge requirements and expensive treatment and disposal alternatives. With EPA and local funding, a study was undertaken to determine the technical and economic feasibility of treating dairy manure in a liquid state by a tandem thermophilic-mesophilic aerobic stabilization process, more commonly described as liquid composting. Experimental apparatus were set up at an operating dairy. The study showed that the liquid composting process must successfully balance the opposing requirements of sufficient oxygen and minimum air flow. Surplus oxygen is required for maximum biological activity wheras the air flow must be minimized to preclude the need for an external heat source. Results with an oxygen-enriched air supply pointed out the potential advantages of a pure oxygen system. Microscopic investigation indicated a greater diversity in the mesophilic microorganism population than in the thermophilic population. This lack of diversity in the thermophilic population can help to explain the finding that the rate of stabilization of manure appeared to be limited at thermophilic temperature as it is at mesophilic temperatures. Cost estimates for a liquid composting process to serve 500 cows were developed within the context of costs for current dairy operations. Estimates showed that significant costs would be added to current dairy operations. Cost of liquid composting was compared with cost of conventional composting. This comparison revealed that the greater costs of liquid composting can be identified with greater capital investment of facilities and with greater energy requirements to bring oxygen, microorganisms, and substrate together. Such informatiion is important in considering whether costs of liquid composting could be borne by current dairy operations. (Montgomery-Consulting Engineers, Inc.; Merryman, ed.)

### 2729-A6,B2,B5,C1,C3,D3
### LIQUID COMPOSTING APPLIED TO AGRICULTURAL WASTES,

Process Engineer, Chemical Research, The De Laval Separator Company, 350 Dutchess Turnpike, Poughkeepsie, New York
A. R. Terwilleger and L. S. Crauer
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 501-505.

Descriptors: Liquid wastes, Equipment, Aerations.
Identifiers: Composting, Treatment efficiency.

Aeration of agricultural wastes at elevated temperatures is a treatment process with many advantageous features. The De Laval Separator Company is presently applying this process to dairy waste, swine waste, and confined beef feedlot waste in the United States. The process, the equipment, and the operational mode of the systems will be described as they treat waste products from actual field installations. The treatment efficiency of these field systems are described in terms of accepted parameters. Advantages cited for this process include a rapid degradation rate, significant solids reduction, reduced viscosity during aeration, significant coliform reductions, odor reduction, and flexibility to meet requirements of varied situations and desired treatment efficiency. (Terwilleger-DeLaval Separator Company)

### 2730-B2,C1,C2,C3,D2,D3
### INVESTIGATIONS ON THE PROCEDURE AND THE TURN-OVER OF ORGANIC MATTER BY HOT FERMENTATION OF LIQUID CATTLE MANURE,

Institut fur Bodenbiologie der Forschungsanstalt fur Landwirtschaft (FAL)
K. Grabbe, R. Thaer, and R. Ahlers
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 506-509.

Descriptors: Fermentation, Liquid wastes, Dairy industry, Organic wastes, Ammonia, Pathogens, Nitrogen, Chemical properties.
Identifiers: Turn-over.

Hot fermentation of liquid manure, caused by self-heating through aeration, took place in a tank with a diameter of 3.25 m, which was equipped with a so-called Fuchs-aerator, or other devices. Dry matter content was increased from near zero to 12 per cent. After intervals of some days, different amounts of fermented material were replaced by fresh manure. Data are given for the temperature course and the turn-over of the organic components. Loss of organic material, nitrogen, and total volume was measured. Balances of energy were made. During the process, ammonia was a source of odor. Its emission increased with temperature and was different with different equipment. Since higher temperatures stimulate the turn-over of organic matter, and trials with salmonellae and different parasites showed that a temperature of about 45 degrees C is necessary to kill the pathogenic agents, a combination of both processes was tested with success. The treated liquid manure's stability varied between two weeks and some months. Experiments in a laboratory fermentor were conducted with the goal of retaining nitrogen. In these studies, in which silage effluent and liquid dairy cattle manure were used, data were obtained on the formation of biomass, its composition, and its fate during the fermentation process and during storage. Distribution of nitrogen in different fractions such as lignin and humic acids was analyzed. Further data are given on investigation on the influence of temperature on pH changes, the problem of alkalinity caused by a resin effect of the organic material, and the possibilities of stabilizing highly concentrated biomass production according to the different aspects of its utilization. (Grabbe-Germany; Merryman, ed.)

### 2731-C2, D3, F1, F4
### OXIDATION DITCHES FOR LIVESTOCK WASTES,

Department of Agricultural Engineering, Illinois University, Urbana
D. L. Day, D. D. Jones, A. C. Dale and D. Simons
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 510-513.

Descriptors: Livestock, Aerobic treatment, Design criteria, Nutrients, Economics.
Identifiers: Oxidation ditches.

This is a state-of-the-art paper proposal on the design and development of oxidation ditches used for aerobic treatment of livestock wastes. The paper summarizes information from several publications that the authors have helped with, such as Illinois Agricultural Experiment Station Bulletin 737 "Aerobic Treatment of Livestock Wastes," the "Aerobic Treatment" chapter of the North Central Regional Publication 206, and the proposed recommendation for the ASAE yearbook "Oxidation ditches for Livestock Wastes." In addition, current practices are included that result from practical as well as research installations. The objective of this paper is to consolidate and summarize literature and recommendations on the use of oxidation ditches for aerobic treatment of livestock wastes beneath slotted floors in confinement livestock buildings. The paper covers such major topics as: (1) Purpose and scope, (2) Description and basic principles, (3) Design criteria, (4) Start-up, (5) Operation, (6) Bath discharge system versus continuous discharge system, (7) Nutritive value of aerobically treated mixed liquor, and (8) Economic and energetic considerations. Types of aerators, circulation patterns, and power efficiencies are discussed. An update of pertinent literature references is included covering projects and installations around the world. (Day, et. al.-Illinois, Indiana, and West Germany; Merryman, ed.)

### 2732-B2,B5,C1,C2,C3,D3
### NITROGEN TRANSFORMATIONS IN AERATED BEEF SLURRIES,

Agricultural Engineer, USDA-ARS-NCR, Minnesota University, St. Paul
R. O. Hegg and E. R. Allred
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 514-516.

Descriptors: Nitrogen compounds, Slurries, Aerobic treatment, Cattle.
Identifiers: Nitrogen transformations.

Laboratory and field studies were conducted to determine the changes in the organic nitrogen in aerated beef slurries under temperatures from 2 to 20 degrees C. Variables measured included pH, dissolved oxygen, organic-nitrogen, ammonium-nitrogen, nitrite-nitrogen, nitrate-nitrogen, total solids, nitrifying bacteria populations of Nitrosomonas and Nitrobacter, and the heterotrophic population. Three batch operated, laboratory experiments, one of 15 weeks duration and two of 20 weeks duration, were conducted in six, 20 liter containers, with duplicates at temperatures of 1.7, 7.2, and 12.8 degrees C under controlled aerated rates and constant mixing to prevent anaerobic zones. The field studies were conducted in a pilot-scale beef oxidation ditch that received waste from 36 animals over a 14 month period. The conclusions were (1) Laboratory, batch operated, continuously fed aerobic digesters produced nitrogen transformations similar to a pilot-scale oxidation ditch. (2) Nitrite-N and nitrate-N concentrations reached several hundred mg/l at temperatures from 2 to 20 degrees C. (3) Nitrifying populations were 1/100 the heterotrophic population. Liquid temperatures from 2 to 13 degrees C did not seem to affect the maximum bacteria population. (4) The nitrifying population appeared to be quite stable even under oxygen limiting conditions. (5) Overall nitrogen balances on the 15 to 20 week experiments resulted in 50-75 per cent nitrogen losses. (6) Nitrite buildups are not due to ammonia toxicity of Nitrobacter bacteria. (Hegg and Allred-Minnesota)

### 2733-A6,B2,B5,C2,D3,F6
### A DESIGN APPROACH FOR THE USE OF AN OXIDATION DITCH FOR LIVESTOCK WASTE TREATMENT,

Research Specialist, Department of Agricultural Engineering, Manitoba University, Winnipeg, Manitoba R3T 2N2
E. J. Kroeker and R. C. Loehr
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 517-521.

Descriptors: Design, Aerobic treatment, Livestock, Poultry, Model studies.
Identifiers: Oxidation ditch, Waste management.

Information is now available for the rational design procedure of the oxidation ditch based upon knowledge of waste characteristics, desired stabilization objectives, and biological waste treatment fundamentals. This paper presents: (1) the development of the design procedure, (2) results of the verification, (3) potential application to other livestock waste situations, and (4) the value of the approach as a management as well as design tool. A mathematical model was developed which includes relevant design and operating parameters for a continuous flow oxidation ditch treatment process. The model serves as a design and management tool for any of the following objectives: (1) odor control, (2) nitrogen removal, (3) nitrogen conservation. The model and resulting design procedure were applied to the design of an oxidation ditch for the treatment of caged-layer poultry wastes. Treatability data were used to establish empirical equations to calculate oxygen requirements, removal of nitrogen by nitrification-dentrification, and the removal of raw waste total solids. The model was verified by utilization of independent data from two large scale treatment systems. Model predicted design parameters were compared to actual operating parameters for two independent systems which are treating the wastes from 4,000 and 15,000 caged layers respectively. The verification indicated that the model could be used as a rational design procedure. In addition, several areas of needed research were identified. (Kroeker and Loehr-Manitoba and New York; Merryman, ed.)

### 2734-C3, D3, F6
### A THEORETICAL DESCRIPTION OF AEROBIC TREATMENT,

Department of Agricultural Engineering, The University of Newcastle upon Tyne, England
J. L. Woods and J. R. O'Callaghan
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 522-525.

Descriptors: Aerobic treatment, Poultry, Model studies, Chemical oxygen demand, Equations.
Identifiers: Swine, Monod theory.

The paper describes a mathematical interpretation of aerobic treatment results for pig and poultry manures. The analysis is based on a theory first postulated by Monod (1942) for single strain cultures and since applied extensively by microbiologists for single strain and mixed microbial populations. The Monod description has been used successfully for sewage and industrial wastes and this particularly recommends it to the animal waste treatment field. The model is applied to laboratory results for pig and poultry wastes. The main features of the resulting equation are: (i) The biological fraction of C.O.D. remaining in the output supernatant is inversely proportional to the micro-organism retention time. (ii) The biological fraction of C.O.D. remaining in the output supernatant is independent of the feed concentration. The micro-organism population adjusts to consume the substrate available. (iii) The treatment characteristics of poultry and pig waste are very similar. The prediction equation for C.O.D. is compared with field treatment plants currently operating in Britain. The agreement is good and these results form a basis for the extension of the model to describe solid and solate biodegradation simultaneously. However, it is important to check these results with the data of other workers for pig and poultry wastes and to extend them to other animal manures. (Woods & O'Callaghan-University of Newcastle upon Tyne; Merryman, ed.)

### 2735-B1, C1, D1, D3, F1
### AN EVALUATION OF AERATION SYSTEMS FOR POULTRY WASTES UNDER COMMERCIAL CONDITIONS,

Research Specialist, Department of Agricultural Engineering, Cornell University, Ithaca, New York
J. H. Martin, Jr. and R. C. Loehr
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 526-529.

Descriptors: Biological treatment, Design criteria, Costs, Poultry.
Identifiers: Odor control, Oxidation ditch, Waste stabilization, Settling tanks.

Cornell Agricultural Waste Management Program is engaged in studying the viability of aerobic, biological treatment of poultry wastes for odor control and waste stabilization. The wastes from 8200 laying hens at Manorcrest Farms, Camillus, New York, are being treated with two oxidation ditches which differ with respect to levels of oxygen transfer. Aeration equipment was sized to meet the total oxygen demand of the wastes in one ditch and only a portion of the total oxygen demand in the other. The result is odor control and nitrogen management in one ditch and only odor control in the other. This study also includes separation of the residual solids following biological degradation by means of settling tanks. This permits low solids concentrations in the mixed liquor which improves oxygen transfer and concentrates solids prior to ultimate disposal. Specific objectives of the study are: (1) Evaluation of available design parameters for oxidation ditches treating poultry wastes, (2) Economic assessment of the process in terms of both capital and operating costs, (3) Identification of problem areas not recognized in smaller scale studies. The paper discusses the study results in terms of: (1) Oxygen requirements for management objectives such as odor control or odor control and nitrogen management. (2) Waste stabilization efficiency in terms of levels of oxygen input. (3) Oxidation ditch channel design which optimizes the aerators capacity of oxygen transfer and mixing. (4) Capital and operating costs in terms of total egg production costs. (5) Performance of the settling tanks in solids removal and concentration. The paper also includes suggested methods of management and alternatives for integrating the oxidation ditch into a total waste management system. (Martin and Loehr-Cornell University; Merryman, ed.)

### 2736-A6, B2, D3, F1
### TURBINE-AIR AERATION SYSTEM FOR POULTRY WASTES,

Research Leader, ARS, USDA, Agricultural Engineering Department, Cornell University, Ithaca, New York
A. G. Hashimoto and Y. R. Chen
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 530-534.

Descriptors: Poultry, Costs, Design criteria.
Identifiers: Turbine-Air Aeration, Odor control, Waste stabilization.

The successful application of aeration systems to control odors and stabilize wastes from livestock operations has been documented. Aeration systems are currently being used commercially and are also being actively investigated under experimental conditions. One of the most serious liabilities of available aeration systems is the relatively high operating costs associated with these systems. This study was undertaken to evaluate the Turbine-Air Aeration (TAA) system in terms of: oxygenation capacity, power requirements, operating costs, and feasibility of treating poultry wastes. Studies were conducted using tap water, and batch and continuous feeding of poultry manure. The TAA system consists of a 54 inch diameter by 10 foot deep tank, with four 4 inch baffles along the circumference parallel to the tank center axis. Two air diffusers are located at the tank bottom below an 18 inch diameter turbine. The major advantage of this system over mechanical (oxidation ditches, surface aerators) or pneumatic (diffused air) aeration systems is the flexibility to obtain optimum mixing and aeration simultaneously, which would result in a more efficient aeration system. Parameters necessary to design Turbine-Air Aeration systems are summarized and design procedures discussed. (Hashimoto and Chen-Cornell University; Merryman, ed.)

### 2737-A8.B2,B3,C1,C2,E2
### SLUDGE MANAGEMENT FOR ANAEROBIC DAIRY WASTE LAGOONS,

Department of Agricultural Engineering, Florida University, Gainesville
R. A. Nordstedt and L. B. Baldwin
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 535-536.

Descriptors: Sludge, Anaerobic lagoons, Dairy industry, Chemical properties, Nitrogen, Economics.
Identifiers: Land disposal, Ruminant wastes, Hydraulic removal, Application rates.

Sludge accumulation rate and sludge composition must be evaluated with respect to the effect on lagoon performance and to the problems associated with sludge removal and dispersal on land. An anaerobic lagoon system on an 800 cow commercial dairy has been receiving wastes for nearly five years. Sludge accumulation rate and sludge composition have been determined. After four and one-half years, dense sludge occupied approximately 28 per cent of the lagoon volume and lighter sludge occupied an additional 45 per cent of the volume. Total solids in the lagoon had increased to an average of 7.49 per cent. Chemical analysis of sludge samples indicates a significant accumulation of nitrogen in the anaerobic lagoon. Total nitrogen in the lagoon averaged 2550 mg/l, representing a total of 17000 kg of nitrogen. Approximately 82 per cent of the nitrogen was in the ammonium form. Other sludge characteristics have also been determined and are discussed relative to the effects of dispersal of the sludge on cropland. Sludge consistency is such that it may be removed hydraulically, using commercially available pumps and other equipment. Scheduling and rate of removal from the lagoon make the use of contract dredging services uneconomical in most cases. A pilot scale sludge removal operation, carried out at the lagoon under study, is discussed; including rates of application on land, effects on soil, and replanting procedures. (Nordstedt and Baldwin-Florida University)

### 2738-B2, C1, C2, D3, E2
### TRENDS AND VARIATIONS IN AN ANAEROBIC LAGOON WITH RECYCLING,

Agricultural Engineering Department, Georgia University, Tifton 31794
C. V. Booram, T. E. Hazen, and R. J. Smith
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 537-540.

Descriptors: Lagoons, Anaerobic conditions, Recycling, Chemical properties, Sludge, Water quality.
Identifiers: Swine, Land disposal.

Changes that have occurred in water quality of an anaerobic lagoon during nine years of recycling at the Swine Nutrition Research Station, Iowa State University, Ames, Iowa are described. Constructed and placed into operation in 1962, water qualiity data on this lagoon were first collected in 1964, shortly after recycling was begun. Since that time data have been collected for the years 1965 and 1968 through 1973. The basic water quality parameters of COD, ammonia nitrogen, kjeldahl nitrogen, chlorides, phosphorus and pH are summarized. Data analysis indicates that ammonia nitrogen, kjeldhal nitrogen, chlorides and COD are increasing with respect to time. Phosphorus concentration has remained relatively constant and pH is gradually decreasing with time. The data collected provide an insight into lagoon water quality changes under a management system of recycling with spray irrigation disposal of the excess. Inferences and an estimation of possible effects of continued recycling are presented. The nutrient content of the sludge in the anaerobic lagoon are presented. Accumulation of sludge is pertinent to treatment system longevity. The lagoon stores and treats the waste products from a 700 head swine confinement building. Since construction in 1962, the lagoon has been sampled 3 times to observe sludge accumulations. The sludge contained 72 per cent of the nitrogen, 89 per cent of the phosphorus and 92 per cent of the organic matter in the lagoon contents. Sludge accumulation occupied 19 per cent of the lagoon volume in 1966 and 30 per cent in 1973. The slower rate of increase in sludge content since 1966 is partly due to biological stabilization during the first few years following construction, and partly because of scme solids removal along with liquid withdrawl. Prior to 1968, the lagoon was periodically discharged to storage ponds. Since then the level has been controlled by irrigation onto adjacent land. With proper design initially and reasonable management thereafter, these data indicate that an anaerobic lagoon for swine wastes should not rapidly fill with accumulated solids. (Booram, et. al.-Georgia University, etc.; Merryman, ed.)

### 2739-A4,B2,C1,C2,D3,E1

### A LAGOON-GRASS TERRACE SYSTEM TO TREAT SWINE WASTE,

Professor of Agricultural Engineering, Missouri-Columbia University, Columbia, Missouri
D. M. Sievers, G. B. Garner and E. E. Pickett
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 541-543.

Descriptors: Waste treatment, Anaerobic lagoons, Performance, Effluent.
Identifiers: Lagoon-grass terrace system, Swine, Chemical build-up.

The waste management system for a swine finishing unit (200 hd) was studied to determine its treatment effectiveness and to assess the system's effect on a nearby municipal water supply reservoir. The system consisted of a slotted floor over an anaerobic lagoon and an 850 ft. grassed terrace. During precipitation events, the lagoon discharged to the terrace where renovation and dilution of the effluent occurred. Leaving the terrace, the liquid flowed an additional 800 ft. and entered the small arm of a municipal water supply reservoir. The anaerobic lagoon was malfunctioning biologically due to chemical build-up. Attempts were made to improve biological activity in the lagoon by pumping the liquid fraction and diluting the sludge with fresh water. Samples of the lagoon effluent and flow in the terrace were analyzed for 14 chemical and physical parameters during a 0.9 inch precipitation event. Over 80 per cent reductions in the concentrations of total and volatile solids, Zn and Cu, and over 90 per cent reductions in COD, $BOD_5$, TKN, total P, Na and K were achieved in the terrace. Soil samples (to 4 ft. taken along the terrace channel indicated that most chemicals held by the soil were largely removed in the first 200 ft. of terrace . . . Controlled discharge of the lagoon coupled with the grassed terrace proved effective in protecting the reservoir from pollution. Annual pumping of the lagoon liquid and dilution of the sludge with pond water produced an average reduction of 50 per cent of all measured parameters and resulted in improved biological activity. However, chemical concentrations built up within one year to higher levels, suggesting that the sludge must be removed to maintain a non-toxic environment in the lagoon. (Sievers, Garner, & Pickett, Missouri University; Merryman, ed.)

### 2740-B1,C1,C2,D2,E3,F6

### BIOENGINEERING ASPECTS OF ANAEROBIC DIGESTION OF PIGGERY WASTES,

Scottish Farm Buildings Investigation Unit, Craibstone, Bucksburn, Aberdeen, Scotland
A. M. Robertson, G. A. Burnett, P. N. Hobson, S. Bousfield, and R. Summers
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 544-548.

Descriptors: Anaerobic Digestion, Energy, Methane, Equipment, Design, Sludge.
Identifiers: Swine, Scotland.

Anaerobic digestion is a method of reducing pollutional load of strong farm wastes which may also provide usable energy as methane. Laboratory studies were used as the basis for design and operation of a small farm scale plant to treat waste from an intensive piggery. Trials with 15 litre and 100 litre continuous digesters showed methods of start-up, operation and minimum turnover times in relation to waste purification and gas production to be expected in large scale digesters. The farm scale plant was designed to give low maintenance, efficient continuous digester of defined performance. The plant consists of a 13,600 litre digester with feed and overflow tanks, feed pump and gas holder. Temperature control (at 35 degrees C) is provided by circulating the digester contents through an external heat exchanger heated by a digester-gas boiler or a stand-by oil fired boiler. After initial seeding with domestic digester sludge, loading of piggery wastes was gradually increased to 450 litre-day at approximately 4 per cent TS and eventually a retention time of 10 days with waste containing higher solids concentrations should be achieved. During the first six months of running, results showed that a stable digestion had been attained; reductions in pollutional load of the whole unsettled waste were on average BOD 91 per cent, TS, 49 per cent, VFA 92 per cent, COD 50 per cent with ammonia generally unchanged. Stirring by heat exchanger flow proved inadequate over long periods; an impermeable crust developed which reformed after breaking. Other methods of stirring are being investigated; at present a twin-disc, slow speed turbine is being tested for optimum speed and time of intermittent stirring. An input of uniform solids concentration is desirable and is provided by a stirrer in the 1800 litre feed tank working for a few minutes before and during operation of the input pump. Digester loading has been stopped with and without heating for days or weeks during over 12 months experimentation. Digestion has always returned to normal soon after loading restarts. Ingress of small amounts of air does not retard digestion but nitrogen appears in the gas. Leakage of large amounts of air eventually stopped digestion; oxygen appeared in the gas but before this nitrogen dilution had stopped gas combustion. Gas production has been equal to or better than the pilot plant values and at 65-70 per cent $CH_4$ gas burns readily to provide a heat source for the digester. At full loading surplus gas should be available for other uses. (Robinson, et. al.-Scotland; Merryman, ed.)

### 2741-B2, C2, C3, D3, F6

### SIMULATION OF FUNDAMENTAL ANAEROBIC LAGOON KINETICS,

Department of Agricultural Engineering, Clemson University, Clemson, South Carolina
D. T. Hill and C. N. Barth
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1974, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 549-552.

Descriptors: Model studies, Mathematical models, Computer models, Anaerobic lagoons, Performance, South Carolina.
Identifiers: Swine, Loading rates.

Laboratory scale models, mathematical modeling, and computer simulation are used to predict the performance of anaerobic lagoons treating swine waste at 10 degrees C and 25 degrees C at varying loading rates. The laboratory units consist of a simple plexiglas reactor placed in environmental chambers simulating typical winter and summer conditions for South Carolina. Feeding rates for each run (at 10 degrees C and 25 degrees C) ranged from .5 to 64 lbs V.S./1000 $ft^3$ -Day. Theoretical detention time for both runs was 200 days. Performance is judged on the basis of volatile matter (V.M) reduction and volatile organic acid (VOA) concentration. The mathematical model interfaces chemical reactor theory with a stoichiometric model of the chemistry of swine waste and a kinetic model of microbial growth. The stoichiometric model provides the basis of conversion of swine waste to soluble organics, VOA, and ultimately to methane and carbon dioxide. The theoretical yields obtained from the stoichiometry are then integrated into a kinetic model of microbial growth and substrate utilization. Inhibition by high organic acid concentration, which occurred throughout the study is incorporated into the mathematical model as well as suppression of the growth and substrate utilization kinetics by an Arrhenius type temperature relationship. The mathematical model assumes that two distinctly different microbial groups are active: 1) acid formers (falcultative heterotrophes) and 2) methane formers (obligate anaerobes). Metabolic and environmental requirements of these two groups are significantly different. Accounting for these differences in the simulation necessitates the use of the two-microbial-culture model . . . The results of the two runs indicate that the conventional techniques used to simulate rapid treatment processes such as activated sludge or trickling filters may not be adequate to model lightly loaded-long detention time biological processes. (Hill & Barth-Clemson University; Merryman, ed.)

### 2742-A3,A4,A6,B2,C2,C3
### D3,E2

### AEROBIC TREATMENT OF PIGGERY WASTE PRIOR TO LAND TREATMENT-A CASE STUDY,

Department of Microbiology, The West of Scotland Agricultural College, Auchincruive, Ayr, Scotland
M. R. Evans, R. Hissett, D. F. Ellam, and S. Baines
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 556-559.

Descriptors: Aerobic treatment, Slurries, Odor, Water pollution.
Identifiers: Swine, Land disposal, Spraying, Scotland.

The investigation was carried out on a 100 ha farm situated at the top of a water catchment area. 5,000-6,000 fattening pigs, fed on a diet of whey supplemented by barley meal and other fibrous and carbohydrate material, where housed there. About 80 $m^3$ of excreta (12-20 g/l $BOD_5$. 20 g/l TSS) drained daily from the piggeries into a 380 $m^3$ slurry tank. This slurry was sprayed onto the land using rain-guns at a rate of 36$m^3$/h. At the start of the investigation both odor and stream pollution caused considerable concern. Chemical and bacteriological examinations of the drainage water, in open ditches surrounding the farm were carried out. Most pollutants gained access to these ditches during the time of spraying slurry onto adjacent fields. However, there was sufficient residual material remaining on the land, to be washed out following rainfall, and encourage slime growth in the ditches. A 10 kW floating surface aerator was installed on the slurry tank to evaluate the use of partial aerobic treatment. Loading rate to this system was 0.15 g $BOD_5$/g MLTSS.d. Mean residence time varied between 4 and 5 days due to spraying operations. Odor was eliminated from the tank and greatly reduced during spraying. Contamination of the water in the ditches adjacent to the sprayed fields with faecal bacteria and organic matter was reduced (maximum $BOD_5$-360 mg/l prior to treatment, 130 mg/l after treatment. To overcome the problems of oxygen limitation and variable loading rate, another 400 $m^3$ tank equipped with three 5 kW fixed surface aerators has been installed. The existing tank and 10 kW floating aerator are used as a combined secondary treatment unit and balancing tank. Continuous monitoring equipment for effluent flow into the main tank and dissolved oxygen, pH and temperature within the tank have been installed. Routine analyses of the mixed liquors and drainage waters are being carried out during the initial operation of this new plant. The two stage system should further reduce organic pollutants without an increase in nitrate concentration and consequent possibility of eutrophication. (Evans-Scotland)

### 2743-B1, C1, C2, D3
### BIOLOGICALLY-CONTROLLED LOADING OF AEROBIC STABILIZATION PLANTS,

Bacteriology Division, School of Agriculture, Aberdeen, Scotland.
K. Robinson and D. Fenlon
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 560-563.

Descriptors: Design criteria, Variability, pH, Fermentation.
Identifiers: Aerobic stabilization plants, Loading rates, Scotland.

Although use of mean values for the BOD, COD, total volume and solids content of raw animal wastes may be acceptable as initial design parameters for aerobic stabilization plants, it is important to remember that in commercial conditions their day-to-day values may vary considerably as a result of changes in stocking density, feed quality and quantity, and a variety of other factors. These factors plus changes in environmental conditions such as pH, dissolved oxygen and temperature make it difficult to achieve steady-state conditions. Even an approximation to steady-state cannot be expected unless allowance is also made during operation for the variable response of the treatment microflora to uncontrolled environmental factors. It was considered that a system of loading responding directly to metabolic activity would permit more efficient operation and ultimately lead to the development and use of an automated farm waste stabilization plant. Feasibility of pH as a loading-control parameter has been studied with the aid of a continuous laboratory fermenter. The fermenter was operated on the basis of a volume of raw waste (supernatant liquor from an anaerobic lagoon for the storage and anaerobic digestion of swine waste) displacing an equal volume of mixed liquor from the treatment vessel. Quantity and frequency of addition were dependent on pH of the mixed liquor and were controlled with the aid of a pH meter controller. Operation of the fermenters at pH values in the range 6.0-8.0 has been examined and compared. The results have shown the ability of the method to control loading rates at retention times of 2-20 days, to prevent large variations in the pH and dissolved oxygen content of the mixed liquor, to produce a stabilized end-product of uniform composition and to virtually eliminate the need for frequent analysis of raw waste quality. Developments are now in hand to test the feasibility of the method under field conditions. (Robinson-Scotland; Merryman, ed.)

### 2744-B2,B5,C1,C2,D3,E3,F6
### PERFORMANCE OF AN AUTOMATED WASTE TREATMENT AND RECYCLE SYSTEM,

Department of Agricultural Engineering, Ohio State University, Columbus 43210
E. P. Taiganides and R. K. White
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 564-567.

Descriptors: Waste treatment, Recycling, Swine, Design, Performance, Effluent, Aeration, Research and development, Feasibility studies.
Identifiers: Oxidation ditch, Settling, Clarification.

A treatment plant consisting of primary settling (stationary screen), aeration (oxidation ditch) and final clarification (settling tank) was constructed in 1971 to receive from a swine confinement unit wastes being flushed out hydraulically. The treated effluent was recycled for flushing liquid. Values used in the design of each component of the system were presented at the 1971 ISLW and were published in the Proceedings of that Symposium. The total system was monitored for 3 full years (June, 1971-May, 1974) with weekly samples and daily supervision. The average monthly BOD removal efficiency of the plant ranged from a minimum of 65 per cent in winter months to a maximum of 88 per cent in summer months with the annual mean being 78 per cent. COD removal ranged from 51 per cent to 76 per cent. Effluent BOD was less than 80 mg/l 50 per cent of the time during the period April through October and less than 140 mg/l for half of the time for the 3-year testing period. Effluent BOD's as low as 24 mg/l were reached during summer periods. Influent BOD averaged 1400mg/l. Average monthly removal efficiencies for other parameters were 67 per cent for COD (51-76 per cent), 82 per cent for TSS (42-94 per cent), 57 per cent for TVS (44-64 per cent), and 43 per cent for maintenance and repair requirements of each of the system components were also monitored and the results will be reported. The purpose of the plant was to demonstrate the technical and environmental feasibility of an automated system of waste removal, collection, treatment and recycle without creating pollution or public nuisance. The plant performance met fully the objectives of the demonstration project. The system can now be considered for marketing. (Taiganides-Ohio State University)

### 2745-A6,B2,B5,C2,D3,E2,F1
### SURFACE AERATION: DESIGN AND PERFORMANCE FOR LAGOONS,

Biological and Agricultural Engineering, North Carolina State University, Raleigh
F. J. Humenik, M. R. Overcash, and T. Miller
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 568-571.

Descriptors: Aeration, Design, Performance, Lagoons, Costs, Effluent.
Identifiers: Swine, Land disposal.

Several pilot and production scale surface aerators both fixed and floating, were investigated to elucidate mechanisms for organic and nitrogen removal as a pretreatment prior to effluent land application. Potential for odor control and nitrification-denitrification were evaluated. In a pilot scale unit (800 ft$^3$) with a variable speed surface aerator, it was found that the two conflicting mechanisms were occurring simultaneously, i.e.: (1) improved stabilization and volatilization, and (2) the restriction of effective settling removal and sludge resuspension. The use of surface area, lagoon volume, aerator horsepower, and anti-erosion plates are discussed as these relate to design and actual field operation. In units operating at 6000 ft$^3$-h.p. and 3750 ft$^3$-h.p. of aeration the supernatant nitrogen levels were both 1200-1400 mg/l with a loading rate of 40 ft$^3$ of lagoon volume-100 lb hog. Sludge depths were 30 inches and 9 inches respectively. Gas evolution was about .11 ft$^3$/day-ft$^2$ of surface area, and gas composition as well as potential of a nitrification-denitrification sequence are discussed. The field scale floating aeration basin is the first stage of pre-treatment for a large swine breeder operation and contains 1 h.p. of aeration per 6,000 ft$^3$ of lagoon (1 h.p. per 1350 ft$^2$ of area). The supernatant nitrogen, phosphorus and organic carbon concentrations are given as well as rates and quantity of sludge accumulation. Actual amount of odor control in surface aeration systems is discussed with consideration of the increased volatilization and the aerobic stabilization of odorous components in the surface aerobic zone and effect on lower anaerobic area. Estimated cost factors for aeration and the overall purpose of such surface aeration basins in a total waste treatment system are discussed. (Humenik-North Carolina State University)

### 2746-A8, B2, C2, D3, F6
### TREATMENT OF LIVESTOCK WASTES BY BARRIERED LANDSCAPE WATER RENOVATION SYSTEM,

Department of Agricultural Engineering, Delaware University, Newark
W. F. Ritter, and R. P. Eastburn
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 572-575.

Descriptors: Waste treatment, Dairy industry, Design criteria, Soils, Phosphorus.
Identifiers: Barriered Landscape Water Renovation System, Mid-Atlantic Region.

Data of laboratory and field studies on barriered landscape water renovation systems to treat dairy cattle wastes are presented. The main objectives of the research are to evaluate the barriered landscape water renovation system to treat dairy cattle wastes in the Mid-Atlantic States and to develop design criteria for barriered landscape water renovation systems for the Mid-Atlantic region. A laboratory study was conducted to evaluate soil types and depth of soil through which livestock wastes percolate for a barriered landscape water renovation system. Laboratory experiments were also conducted to evaluate the changes in levels of dilute acid soluble phosphorus. Data are presented for a 900 ft$^2$ barriered landscape water renovation system operated over a 9 month period. The data include COD, nitrogen, and phosphorus removal rates for the 9 month period. (Ritter-Delaware University; Merryman, ed.)

### 2747-B2, C1, C2, D1
### TERTIARY TREATMENT OF ANIMAL WASTEWATERS BY REVERSE OSMOSIS MEMBRANES,

Department of Agricultural Engineering, Ohio State University, Columbus
B. S. Mehta and E. P. Taiganides
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 576-579.

Descriptors: Tertiary treatment, Waste water treatment, Reverse osmosis, Animal wastes.
Identifiers: Membrane separation system.

Membrane systems have been employed to produce high quality potable water from saline waters and from a variety of supply sources. However, they have not been applied to purification of animal wastewaters. The purpose of this study was to test the efficiency of membrane separation system for the clarification of biologically treated animal wastewaters. An experimental apparatus was developed. The main components of the apparatus were the membrane module, high pressure pump, and appurtances for recording and collecting samples. Samples tested were taken from effluents of an anaerobic lagoon, an aerobic pond, and from the Automated Waste Treatment and Recycle Plant in Botkins, Ohio. Efficiency of removal was determined by changes in the concentration of the following parameters: TS, TSS, TDS, BOD, COD, nitrogen, phosphorus, conductivity, pH, color and turbidity. Removal efficiencies were measured at 5 levels of operating pressure, at 5 various influent temperatures, and at 5 different flow rates. Operational efficiencies were also evaluated and an estimate was made of the cost of tertiary treatment of biologically treated wastewaters. Color and turbidity removal was so high as to make the effluent look potable. Removal efficiencies achieved in other parameters were above 90 per cent. (Metha-Ohio State University)

### 2748-A3,A4,A5,A8,B1,C1,C2,C3,E2,F3,F4
### PRESENT KNOWLEDGE ON THE EFFECTS OF LAND APPLICATION OF ANIMAL WASTE,

Department of Agronomy, Kansas State University, Manhattan

G. W. Wallingford, W. L. Powers, and L. S. Murphy
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 580-582.

Descriptors: Animal wastes, Soils, Physical properties, Chemical properties.
Identifiers: Literature review, Land disposal, Loading rates.

The purpose of this research was to review the literature and analyze research needs on the effects of land disposal of animal waste. A secondary objective was to assemble published information on application guidelines for animal waste. Included is information on characteristics of the waste, effects of waste on soil and water near the application site, loading rates, application techniques and research needs. Waste characterization data in the literature were compiled by recording all usable data and classifying them by climatic region, species (animal), and type (liquid or solid) of waste. The variability in composition within a climatic region, species and type of waste was so great that no general characterization could be made within each classification. Factors affecting the composition of the waste are discussed. Effect of land disposal on the physical, chemical and biological properties of the soil are discussed as well as its effect on groundwater quality below the disposal site, runoff quality from the disposal site, and plant growth on the disposal site. A discussion on the benefits of animal waste disposal as well as the hazards of animal waste disposal on land is given. Existing literature is discussed with the ultimate objective in mind of developing application guidelines for animal waste disposal. Where insufficient literature exists to develop these guidelines, research needs are discussed. (Wallingford-Minnesota University; Merryman, ed.)

### 2749-A8, B2, B3, E2

### COMPARISON OF LINT COTTON FIELDS FOLLOWING APPLICATIONS OF BEEF CATTLE WASTES AND COMMERCIAL NITROGEN,

Delta Branch, Mississippi Agricultural and Forestry Experiment Station, Stoneville
W. I. Spurgeon, J. M. Anderson, and J. W. Holloway
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 583-586.

Descriptors: Cattle, Cotton, Yields, Liquid wastes, Solid wastes, Soils.
Identifiers: Land application, Application rates.

The objectives of the research were to: compare liquid vs. solid manure from beef feedlots for cotton production; compare injections of liquid manure to surface application; and evaluate cotton yield response to various manure application rates on two soil types. Lint cotton yields following application of 40, 80, 120, and 160 lb/ac of commercial nitrogen were compared with 4, 8, 12, and 16 tons/ac of solid and liquid manure on a Dubbs silt loam soil in 1972. Liquid or solid manure applied at a rate of 16 tons/ac or 120 lb of N/ac resulted in lint cotton yields of 926, 965, and 944 lb/ac, respectively. Injection of 24 tons/ac of liquid manure in 1972 and 24 and 36 tons/ac in 1973 into Dubbs silt loam soil resulted in yields of 1141, 1036, and 1141 lb lint cotton per acre, respectively. These yields were greater than yields of 981, 883, and 987 lb/ac following comparable rates applied to the surface of the soil. Liquid manure injected into the soil at 24 tons/ac of liquid manure in 1972 and 24 and 36 tons/ac in 1973 resulted in lint cotton yields similar to those obtained following 120 lb of N/ac (1089 vs. 1135 and 1141 vs. 1178 lb/ac, respectively). During 1973, 18, 24, 30, and 36 tons-ac were applied across 0, 50, and 100 lb N/ac on a Dubbs silt loam soil. Lint cotton yields for manure rates were 1120, 1182, 1187, and 1116 lb/ac, respectively. Across all rates of liquid manure, application of the zero level of N resulted in lower lint cotton yields when compared to 100 lb of N/ac. There was no interaction between rate of manure and rate of N applied. Peak lint cotton yields occurred in the range of 24 to 30 tons/ac of liquid manure. Liquid manure was injected into Sharkey clay soils at rates of 24, 36, and 48 tons/ac in 1973 and compared to 120 lb of N/ac. Lint cotton yields were 683, 725, 761, and 761 lb/ac, respectively. (Spurgeon-Mississippi; Merryman, ed.)

### 2750-A8,B2,B4,C2,C3,E3

### ON-THE-FARM DETERMINATION OF ANIMAL WASTE DISPOSAL RATES FOR CROP PRODUCTION,

Professor of Soil Science, Washington State University
D. O. Turner
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 587-590.

Descriptors: Waste disposal, Pacific Northwest U.S., Crop response, Denitrification, Leaching, Equations, Dairy industry.
Identifiers: Waste management, Disposal rates.

Livestock operators in the Pacific Northwest need a means whereby they can estimate waste loading capabilities of their soils. Seventy per cent of the 300,000 dairy cows in Washington and Oregon are west of the Cascade mountains in areas having heavy winter rainfall. Waste disposal poses pollution problems which are especially troublesome when alluvial soils are saturated. Waste handling and transport systems in conjunction with field applications are under study at three dairy locations; cattle populations range from 130 to 350 head. Two installations receive 40 to 60 inches annual precipitation; one gets 20 inches annual rainfall. Detention ponds for winter storage and pumppipe distribution systems are used at all locations. A soil injection system is also used at one site. Tile drainage effluent from beneath lagoons is being monitored for $NO_3$-N and coliform bacteria at one location. Data indicate the effluent to have less pollution than does the stream into which discharge occurs. Waste loading rates are being defined at all locations under field conditions. Crop removal of nitrogen is being measured with silage corn, cereal rye, and forage grasses. Nitrate-nitrogen concentrations in the forage are being determined as are $NO_3$-N concentrations in the soil profile to a 4-foot depth. Results indicate large amounts of animal manure can be applied to soils in the Northwest without accumulation of toxic $NO_3$-N in animal feed. A large amount of nitrogen is being denitrified. Soil nitrate leaching is minimal in the operations. These data are being used as a base to develop equations to estimate: (1) Manure nitrogen to provide for optimum crop yields without excessive nitrogen losses from volatization, denitrification, or leaching; and (2) Amount of residual manure nitrogen remaining for following years. (Turner-Washington State University; Merryman, ed.)

### 2751-A3,A8,B2,B3,C2,E2

### DISPOSAL OF DAIRY CATTLE MANURE ON SOIL,

Soil and Water Research, USDA, ARS, Auburn University, Auburn, Alabama
Z. F. Lund, F. L. Long, B. D. Doss, and F. E. Lowry
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 591-593.

Descriptors: Dairy industry, Cattle, Soils, Crop response, Forages, Agricultural runoff.
Identifiers: Land disposal.

Application of dairy manure to soil is an economical means of disposal, but high application rates may cause problems with quality of runoff water and forage. Dairy cattle manure was incorporated into the surface 15 cm of a Norfolk sandy loam and cropped with millet (Pennisetum americanum (L.) K. Schum) and rye (Secale cereale). Applications of 45 mt/ha/yr for 3 years resulted in BOD values of runoff water that did not exceed those for nonmanured plots. The nitrate-nitrogen content of runoff water was essentially unaffected by the manure treatment; the maximum did not exceed 3.7 mg/liter and averaged less than 2 mg/liter. Total N lost in runoff water averaged less than 3 kg/ha/yr. The same cropping system was used on plots of Dothan loamy sand, Lucedale sandy loam, and Decatur clay loam. Plots received 22.5, 45, 90, 180, and 270 mt/ha/yr of manure on a dry weight basis. The check plot received N, P, and K fertilizers totalling 450, 220, 450 kg/ha. The 180- and 270-ton manure rates caused plant injury the first year on both sandy soils. Millet yields were higher on the 45- and 90-mt-ha rates than on the check plots 2 out of 3 years. Both millet and rye forage produced on 180- and 270-mt/ha treatments had K-(Ca+Mb) ratios and nitrate levels that were potentially hazardous to animal health. Coastal bermudagrass (Cynodon dactylon (L.) Pers.) on Dothan and Lucedale soils received rates of 45 and 90 mt/ha/yr of solid manure and 45, 90, and 135 mt/ha/yr of liquid manure. Four applications of N, P, and K fertilizers were made to the check plots annually for a total of 470, 225, and 470 kg/ha. The mineral fertilizer plots yielded more forage the first year on the Dothan soil, and the second and third years on the Lucedale soils, than any manure treatment except the 90 and 135 mt/ha of liquid. Nitrate nitrogen in the forage was highly correluted with organic nitrogen in the plant tissue. Manure could be applied at the 45 mg/ha rate, either incorporated or on a Coastal bermudagrass sod, and produce nontoxic forage. (Lund-Auburn University)

### 2752-A8,A11,B2,B3,B4,C2,E2

### FERTILIZER VALUE OF LIVESTOCK WASTES,

The Agricultural Institute, Soils Centre, Johnstown Castle, Waxford, Ireland
H. Tunny
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 594-597.

Descriptors: Fertilizers, Livestock, Nutrients, Performance, Slurries, Solid wastes, Silages, Nitrogen, Phosphorus, Potassium.
Identifiers: Application rates.

Results of experiments on nutrient composition of animal manures and the efficient use of these nutrients for grass production are presented. The first experiment deals with the variation in N, P, K and dry matter composition of manures from 70 cattle, pig and poultry farms. Manure stored as slurry had a wider variation between farms than manure stored as solid. Pig slurry showed the widest variation between farms; dry matter ranged between 1 and 21 per cent and nutrients also showed a wide variation. The other manure samples showed approximately a two-fold variation between highest and lowest farms. Results of the second experiment compared chemical fertilizer with cattle slurry and pig slurry as a source of nutrients for grass silage in 1973 and 1974. Nutrient levels applied, yields and results of plant and soil analysis are presented and discussed. Nitrogen in cattle slurry was approximately half and nitrogen in pig slurry two-thirds as effective as nitrogen in chemical fertilizers. Cattle slurry with adequate nitrogen supplied excess potassium and inadequate phosphorus; whereas, pig slurry supplied inadequate potassium and excess phosphorus. The silage from the three treatments was fed to three groups of animals. Feed intake and liveweight gain were recorded as an index of palatability, and silage quality. There was no significant difference in animal performance. In addition, a third experiment studied the effect of time of application and response of different grass species to animal manure. Preliminary results suggest that time of slurry application relative to time of cutting influenced grass production. (Tunney-Ireland; Merryman, ed.)

2753-A3, A8, B2, C2,E2

### PLANT AND SOIL EFFECTS OF SWINE LAGOON EFFLUENT APPLIED TO COASTAL BERMUDAGRASS,

North Carolina State University, Raleigh
G. A. Cummings, J. C. Burns, R. E. Sneed, M. R. Overcash, and F. J. Humenik
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 598-601.

Descriptors: Coastal Bermudagrass, Sprinkler irrigation, Design, Crop response, Agricultural runoff.
Identifiers: Swine, Land application, Lagoon effluent, disposal, Application rates.

Design, installation and operation of a completely automated permanent sprinkler irrigation system for land application of swine lagoon effluent on coastal bermuda grass is described. This system utilizes part-circle impact sprinklers located on the 4 corners of each 30 x 30 foot plot. The system is controlled by an electrically-operated turf-type controller, and water flow to individual sprinklers is controlled by thermal hydraulic remote solonoid values. During the first year of effluent application (1973) losses from runoff were negligible for P and low for all other constituents measured. With annual N application rates of 264, 527 and 1055 pounds per acre losses were 4, 9, and 17 lbs per acre with approximately the same K rate of application losses were 9, 17, and 38 pounds per acre. Per cent loss from runoff of Ca, Mg and Na were approximately the same as the per cent loss of N. Crop recovery of P, Ca, Mg and Na was much lower than recovery of N and K. Effluent application did not have a detrimental influence upon the forage in 1973 nor through August in 1974. Yields in 1973 were approximately 5, 6.5 and 7 tons of dry matter per acre as effluent application rates were increased. Nutrient balance sheets incorporating data from crop yield and analysis, runoff losses, soil analysis, and effluent application rates are presented. (Cummings-North Carolina State University; Merryman, ed.)

2754-A4,A5,A8,B3,C2,D3, E2,F1

### POLLUTION ABATEMENT OF POULTRY MANURE BY MAXI-MIXING METHOD,

Animal Science Department, Connecticut University, Storrs
W. A. Aho, G. F. Griffin, and A. K. Bakir
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 602-605.

Descriptors: Poultry, Costs, Waste disposal, Sampling, Nitrates, Nutrients, Anaerobic conditions, Pollution abatement.
Identifiers: Maxi-mixing, Composting.

Maxi-mixing is a term coined to describe a manure disposal system using a maximum amount of manure and a minimum amount of soil in a composting situation. Manure is returned to the soil system in massive quantities at low cost. Actual mixing is accomplished with a bulldozer or a payloader, folding manure and soil and windrowing. Odors are quelled almost immediately and under ideal temperature and aeration, composting occurs in several weeks. In November of 1970, 3,675 tons of poultry manure (50 tons nitrogen) was mixed in an area less than 2 acres. The area was too small to provide enough soil for a windrowed compost. The manure remained below ground level in a wet anaerobic state. The area surrounding this mass was sampled for nitrate and ammonia movement in 1971 and 1972. A brook flowing adjacent to the mix was monitored in 9 locations; 12 holes were also drilled to obtain ground water samples, and the farm well was sampled. No appreciable amounts of nitrates were found. The mix lay fallow from November, 1970 until April, 1974, when the site was required for disposal of another 6,300 tons of poultry manure. The site was appraised and soil samples and analyses were made. The analyses of soil three years following massive manure mixtures indicated high pH values (8.1 to 8.2) in manure residual zones and relatively high soluble salts (83 to 90 mhos x $10^{-5}$), very high ammonium levels (400 ug N-g soil) and very high levels of extractable calcium, phosphorus and potassium. Only a trace of nitrite was found in the samples. After the second maxi-mix water samples were taken from the adjacent brook and the farm well, neither showed pollution from the maxi-mix. Cost of maxi-mixing was 62 cents a ton in 1970 and 60 cents a ton in 1974. (Aho-Connecticut University; Merryman, ed.)

2755-A4,A5,A13,B2,E2,F1

### ON LAND DISPOSAL OF LIQUID ORGANIC WASTES THROUGH CONTINUOUS SUBSURFACE INJECTION,

Department of Agricultural Engineering, Colorado State University, Ft. Collins
J. L. Smith, D. B. McWhorter, and R. C. Ward
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, 1975, p. 606-610.

Descriptors: Liquid wastes, Design, Costs, Dairy industry, Labor, Colorado.
Identifiers: Land disposal, Subsurface injection, Application rates.

Design, development, and utilization of a continuous liquid manure subsurface injection system are discussed. With the system, liquid manure is pumped from a holding tank or lagoon to a disposal field through rigid pipe. A 660 foot flexible hose is used to connect the pipeline to the mobile injector. The manure is injected at depths of 4 to 6 inches below the soil surface and mixed with soil thus minimizing the possibility for aesthetic pollution. The injector can be operated with a medium sized agricultural tractor. Disposal capacity ranges from 400 to 800 gpm of 5 per cent solid slurry depending upon the size of the equipment. A skilled operator can achieve application rates in excess of 50,000 gallons per acre per pass. The system is particularly adapted for use near population centers. The system is presented as an economically and environmentally sound alternative to current practices. Measurements of ground and surface water contamination are reported from on-going research where the system is being used on a dairy in Northern Colorado. The system offers significant savings in labor while improving the aesthetics of animal waste management. Operating costs are competitive with present systems. (Smith-Colorado State University)

2756-A8, B1, C2, E2

### SOIL PROPERTIES AND FUTURE CROP PRODUCTION AS AFFECTED BY MAXIMUM RATES OF DAIRY MANURE,

Minnesota University, Southern Experiment Station, Waseca
G. W. Randall, R. H. Anderson and P. R. Goodrich
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 611-613.

Descriptors: Dairy industry, Chemical properties, Nutrients.
Identifiers: Land disposal, Application rates, Noncrop areas, Pollution potential.

Conditions sometime exist in livestock operations where acreage, time and/or labor may not be sufficient to allow manure application to land just prior to crop planting or at conventional rates. An experiment was established to determine the maximum amount of manure that can be applied and incorporated in a limited non-crop area. During 1971, 1972, and 1973, dairy manure was applied to the surface of a Webster clay loam soil. Manure was applied to the same 0.5-acre area in both 1971 and 1972. In 1973 this area was split and manure was applied to one of the 0.25 acre areas. In 1973 corn was planted on the other 0.25-acre area and on an adjacent border area that had received 32.7 T DM/A in 1970 and had been fallowed since. Manure application rates have totaled 103, 95.7 and 144.8 T-A (dry matter basis) for 1971, 1972 and 1973, respectively. Nutrient application rates over the 3-year period have totaled 20,150 lbs. N/A (76 per cent as organic N), 5845 lbs P/A, 10,785 lbs. K/A and 11,285 lbs. Cl/A. Soil samples taken in April, 1973, following 198.7 T/A, showed that nitrates had moved only to 5'. Chlorides had moved to 8'. Ammonia P, K and Na had accumulated in the 0-1' layer. Following 343.5 T/A, the 1974 sampling showed that some nitrates had moved to 6'. However, nitrate concentrations in the 1-2, 2-3, and 3-4' depths were very low and indicate that denitrification could have occurred. Soil water samples revealed nitrate concentrations under the manure area to be 50 per cent less than those from the fallowed border area until August, 1973. Since then nitrate concentrations under each have been similar. Chloride concentrations were about 3 times higher under the manure. In 1973, corn yielded 152 bu/A from the manure area and 191 bu/A from the fallowed border area without fertilizer. Additional crop yields and soil and water samples must be taken annually before long-term effects can be determined. (Randall-Minnesota University; Merryman, ed.)

2757-A8, B3, B4, C2, E2

### COMPOSITION OF POULTRY MANURE AND EFFECT OF HEAVY APPLICATION ON SOIL CHEMICAL PROPERTIES AND PLANT NUTRITION, BRITISH COLUMBIA, CANADA,

Soil Science Department, British Columbia University, Vancouver, Canada
A. A. Bomke and L. M. Lavkulich
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 614-617.

Descriptors: Poultry, Chemical properties, Crop response, Soil contamination, Waste storage.
Identifiers: Canada, Land disposal.

The lower Fraser Valley of British Columbia, Canada has a poultry population of approximately 8.5 million birds. This is the most densely populated area of the province and one which supports the most intensive agriculture. Thus waste disposal has become an acute problem from the standpoint of environmental quality. Application of large amounts of animal wastes to land and the subsequent growth of crops raises the question of crop quality. A program was initiated to determine: (1) The effect of heavy application of poultry manure on soil chemical properties, drainage waters, and crop composition, and (2) Plant nutrient content of poultry manure deposited and stored in deep pits under laying cages. Adverse effects on vegetation of excessive rates of manure were visually apparent when soil and plant samples were collected from several fields used as manure disposal sites. Available P levels as high as 1100 ppm are indicative of potential problems of excessive manure application. Other soil parameters considered are total N, $NO_3$-N, $NH_4$-N, exchangeable cations, electrical conductivity and pH. In addition, tissue analysis of plants collected from disposal sites and cropped fields is used to indicate possible plant nutrient imbalance due to high manure application rates. Types of vegetation sampled include primarily grasses on the disposal sites, some cropped fields, and raspberries, a crop receiving significant quantities of poultry manure in B.C. Proper use of manure requires knowledge of its composition, which is highly dependent on storage methods. Therefore, an evaluation was made of plant nutrient content of manure deposited and stored in deep accumulation pits under laying cages, a system which is used in most new laying houses in B.C. Samples were collected at 15 cm increments from manure piles with an average depth of 90 cm. Manure from lower increments had been stored up to one year. Results of analysis of the manure are evaluated in terms of changes in plant nutrient content during storage. Application rates of poultry manure and their ensuing effects on soils and crops are dependent on an understanding of the type of management system. (Bomke-Canada)

## 2758-A3,A8,B2,D3,E2,E3,F1

### AN OVERLAND FLOW-LAGOON RECYCLE SYSTEM AS A PRETREATMENT OF POULTRY WASTES,

Biological and Agricultural Engineering, North Carolina State University, Raleigh
M. R. Overcash, J. W. Gilliam, and F. J. Humenik
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 618-621.

Descriptors: Poultry, Waste treatment, Design, Costs, Terracing, Lagoons, Denitrification.
Identifiers: Overland Flow-Lagoon-Recycle System, Waste water recycling.

A sequential arrangement of process in this caged layer waste management system is presented. Waste from 1400 layers is removed from undercage collection channels once per day by flush water (2500 gal) which is held in a storage tank and released so that flow rates of 15-20 feet per second are obtained initially. A flow velocity of 3-5 ft-sec at the end of the waste collection channel results in effective cleaning. The manure slurry is then mixed in a tank and pumped to a dilution box, from which the wastewater is distributed at the upper end of 3 terrace systems by means of a 4" x 4" x 40' long trough with slotted openings at ground level. Two terrace systems are 8 per cent slope, and one is 6 per cent. At 50 foot intervals the overland flow liquid is collected, measured and sampled and then redistributed as described above. The cover crop is predominantly Reed Canary grass and is harvested with yields taken every week. To evaluate the nitrifying mechanisms soil surface samples have been taken and analysed for Nitrosomonas and Nitrobacter. The objective is to select the flow distances and operational parameters which promote nitrification without excessive carbon stabilization in overland flow. Terrace runoff is directed into an 18,000 ft$^3$ unaerated lagoon. This serves as a denitrifying site for nitrates formed in the overland flow. Following this basin is a large holding-polishing lagoon from which water is recycled to the flush reservoir and dilution box. This recycle system does not represent a totally closed system because salt or other toxic elements will build with time necessitating the application of the system liquid to the land and a dilution of the system with fresh water. Design factors, costs, and operational strategies for typically-sized producer systems are included. Several alternative designs for various parts of the overall system are included to enhance applicability to a wider range of producer situations. (Overcash-North Carolina State University; Merryman, ed.)

## 2759-A6, A10, B1, F1

### HIGH RISE POULTRY HOUSES,

New Zealand Journal of Agriculture, Vol. 125, No. 3, p. 71, September, 1972. 2 fig.

Descriptors: Economics, Odor.
Identifiers: High rise poultry houses, New Zealand, Advantages, Disadvantages.

The advantages and disadvantages of high rise poultry houses are discussed as applicable to New Zealand's poultry industry. The advantages include: only annual manure removal is needed (sometimes extended to longer intervals); freedom from offensive poultry odors and flies; easy servicing and cheaper running costs; acceptability to pollution-conscious public. The disadvantages include: higher initial capital costs; vermin control is not easy in the pits; and keeping the pit area free of water can be difficult. (Solid Waste Information Retrieval System)

## 2760-A6,A11,B3,B4,C2,E3

### POULTRY MANURE AS A LIVESTOCK FEED (PART 1),

Dohne Research Institute and Bathurst Research Station
E. J. B. Bishop, P. I. Wilke, W. J. Nash, J. A. G. Nell, et. al.
Farming in South Africa (Pretoria), Vol. 46, No. 11, p. 34-36, February, 1971. 5 fig, 1 tab.

Descriptors: Poultry, Livestock.
Identifiers: Refeeding, Hen-laying manure, Chicken litter, Overeating.

There are two types of poultry manure which can be used as feed for livestock. The first type is hen-laying manure. This product is left under the laying batteries for 4 to 12 months before being removed. It is then dried to improve the storing ability and to eliminate unpleasant odors. The second type of poultry manure is chicken litter and is the result of chickens being raised on absorbent material such as wood shavings, chaffed hay, and straw or peanut hulls. Chicken litter is dry and easily handled as well as clean smelling; therefore it is the most popular livestock feed. These two types of feed vary greatly in most instances but compare favorably with lucerne in total digestible nutrients (50 per cent) and crude protein (13 per cent). Although the nutrient value is good, problems are frequently encountered when poultry manure is first used. Chicken litter is much more readily accepted, and in some cases, overeating may occur. Acceptance of the manure may be increased by adding molasses to the feed for the first few days, and overacceptance can be remedied by inclusion of 20 per cent salt. (Solid Waste Information Retrieval System)

## 2761-A11,B3,C1,C2,D1,E3

### POULTRY MANURE AS A LIVESTOCK FEED (PART 2),

Dohne Research Institute and Bathurst Research Station
E. J. B. Bishop, P. I. Wilke, W. J. Nash, J. A. G. Nell, et. al.
Farming in South Africa (Pretoria), Vol. 46, No. 12, p. 49, 51, 53, March, 1971. 4 tab.

Descriptors: Poultry, Livestock.
Identifiers: Refeeding, South Africa.

Farmer utilization of poultry manure in South Africa, which is increasing, includes the use of sun-dried laying-hen manure in a large steer-fattening project, the use of chicken litter to supplement the feed of beef-breeding cows, and the use of poultry manure to supplement the diet of sheep-stud rams, ewes, and lambs. Though the extreme drought gave impetus to the use of this feed supplement, experimental results now indicate that the use of poultry manure supplies vital protein, phosphorus, and energy cheaply. As a winter supplement to cattle and sheep on winter sourveld, it is both useful and economical. Usually the poultry manure is mixed and fed with feeds such as molasses meal, maize meal, and milled hay. Though molasses provides palatability and is used as a binding agent, some farmers now are using poultry manure without the molasses and are processing it into cubes. It can be made with chicken litter, or with a mixture of 20 per cent laying-hen manure, maize meal, and teff hay, which was found to be acceptably palatable, durable, and fracture-free. However, the cubed rations cost more than the uncubed feed. Where laying-hen manure does not constitute the major proportion of the total diet, it can be used with safety for the feeding of breeding stock. (Solid Waste Information Retrieval System)

## 2762-A6, B1, B4, E2, F1

### MANURE HANDLING SYSTEMS AND ENVIRONMENTAL CONTROL FOR CONFINED DAIRY HOUSING,

Department of Agricultural Engineering, Minnesota University, St. Paul
D. W. Bates
Journal of Milk and Food Technology, Vol. 34, No. 3, p. 129-132, March, 1971. 6 ref.

Descriptors: Dairy industry, Environmental control, Odor, Costs, Ventilation.
Identifiers: Waste handling.

Odor and the appropriate time of disposal are two of the most difficult waste problems facing dairymen. Handling systems may range from a gutter cleaner and daily hauling with a manure spreader to extend storage in concrete tanks whose contents are pumped and spread periodically. Daily hauling requires the lowest investment in equipment, but has the disadvantage of possible higher labor costs and the hazard of encountering unfavorable weather, soil, or crop conditions. Slat floors in warm freestall barns, or gutters with grated bottoms in conventional stall barns, both with under-the-building manure storage, offer suitable systems for manure handling with a minimum of labor. Carefully planned ventilation systems of high capacity must be provided for all confined units. Manure containing little bedding deposited in the end of a 150,000-gal tank will distribute itself under its own weight. Waste heat from the dairy barn ventilation system can be used to prevent the manure from freezing. Cost estimates of various methods are included. (Solid Waste Information Retrieval System)

## 2763-A4, A7, A8, B1, F2

### ROLE OF THE DAIRY AND FEED INDUSTRY IN ENVIRONMENTAL POLLUTION CONTROL,

Environmental Health Technology Department, Broome Technical Community College, Binghamton, New York
D. F. Newton
Journal of Milk and Food Technology, Vol. 33, No. 12, p. 568-570, December, 1970. 4 ref.

Descriptors: Dairy industry.
Identifiers: Food industry, Pollution control.

There are three roles which the dairy and food industry assumes—the role of a potential or actual polluter, the role of an educator, and the role of a community leader. In St. Lawrence County, New York, the New York State Health Department, in its initial water pollution survey of that region conducted in 1960 cited no less than 15 dairies as polluters. The industry also contributes to air pollution, and produces significant quantities of solid waste, indirectly contributing to land pollution. Wastewater from milk houses and milking parlors and sanitary sewage from farm houses constitute potential pollutants on dairy farms as does wastewater from milk and food processing plants. Boilers and heating facilities in food processing plants are potential sources of pollutants. Dairy and poultry farms produce enormous tonnages of manure. Processing plants produce much solid waste such as vegetable and fruit trimmings and spoiled food. It is suggested that dairies can print statements about pollution control on milk cartons. Administrative and supervisory personnel from the dairy and food industries could participate in Chamber of Commerce programs which now include pollution control activities. (Solid Waste Information Research System)

## 2764-A8, B1, C2, D3, E2

### THE REMOVAL OF ANIMAL EXCREMENTS FROM MASS-STOCK FARMS AS A WATER ECONOMY PROBLEM,

K. Th. Rager
Wasser und Boden, Vol. 24, No. 5, p. 131-134, May, 1972. 5 tab.

Descriptors: Fertilizers, Nitrogen, Calcium, Sewage treatment, Netherlands.
Identifiers: Land disposal.

Normally the excrements from animals are removed in agriculture by using them as manure on the fields. However, if the number of animals passes a certain limit it is no longer possible to use the feces in rural areas since there is the danger of over-fertilization owing to the high nitrogen and calcium concentrations in the excrements. For this reason mass-stock farms have to remove the excrement by means of biological sewage treatment plants. From 1968 to 1969, 27 such biological sewage plants have been constructed in the Netherlands, which have the longest experience in this field. A biological sewage plant for animal excrements furnishes about 49 per cent of surplus sludge when treating beef dung, about 9 per cent surplus sludge when treating calf dung, and 40 per cent when treating pork dung. The BOD values in these plants correspond to the normal requirement of 25 mg per 1. About 90 per cent of P and N are eliminated at a sludge load of 0.03 kg per kg dry substance. Another method to dispose of animal excrements applied mostly in the USA, is the plow-furrow-cover method. This method however does not use the excrements as manure but disposes of them in a special kind of sanitary landfill. (Solid Waste Information Retrieval System)

## 2765-A5, A8, C2, E2

### ANIMAL WASTES: PHYTOTOXIC EFFECTS ON PLANT GROWTH; INFLUENCE ON THE FEEDLOT SOIL PROFILE,

G. E. Schuman
PhD Dissertation, Department of Agronomy, University of Nebraska, May, 1974, 56 p. 13 fig, 14 tab, 44 ref.

Descriptors: Phytotoxicity, Crop response, Feedlots, Potassium, Soil permeability, Germination, Groundwater pollution.
Identifiers: Seedling development, Land disposal.

Extracts were taken from beef cattle manure and analyzed by bioassay techniques to determine the effects of such extracts on the germination and seedling growth of wheat and sorghum. Distilled water, acetone, methanol, ether, and 2N HCl were used in performing these extractions. The water extract stimulated seed germination but reduced seedling development due to the high salt content of the extract. Of the acids identified and quantified by the ether extract, propionic acid was found to stimulate seedling development at levels of 200 ug/ml or less. However, the fatty acids, in combination, had a detrimental effect. Soil profile samples were taken from a river-basin feedlot and adjacent field in order to determine the effect of the cattle-feeding operation on the chemical properties of the soil and their effects on the future uses of the soils. Feedlot soil profiles revealed an exchange complex in the top 15 cm. of the soil that was saturated with potassium. This zone of high exchangeable potassium and organic matter limited water permeability. The presence of nitrate was virtually nil beneath this impermeable layer. Undisturbed soil columns that were obtained from the feedlot seemed to confirm that the potassium probably plays a role in the formation of an impermeable zone. The maintenance of this impermeable layer is necessary for prevention of pollution of groundwater by cattle feedlots. (Penrod-East Central)

## 2766-A9,A10,A11,B2,C2,D3, F5

### AQUATIC ECOLOGY OF SWINE WASTE LAGOONS BEFORE AND AFTER ARTIFICIAL AERATION,

J. A. Tranquilli
PhD. Dissertation, Illinois, Urbana-Champaign, September, 1974, 172 p. 18 fig, 31 tab, 61 ref.

Descriptors: Lagoons, Aeration, Fish, Mosquitoes, Water quality.
Identifiers: Swine.

Studies were conducted in order to: (1) monitor water quality parameters in three lagoons at the University of Illinois and determine the effects of artificial aeration on the parameters studied; (2) determine whether fish could survive, grow, and reproduce under the extreme conditions present in swine waste lagoons; (3) determine the effects of various control methods on mosquito populations plaguing livestock waste lagoons. The study revealed that 13 of the water quality parameters were significantly different between stations. There was a significant negative correlation between water temperature and both total kjeldahl nitrogen and ammonia nitrogen at all stations. Dissolved oxygen (DO) concentrations at the 1-foot level, DO concentrations at the bottom, and the depth of the water were the only parameters which were significantly different between aerated and unaerated stations within the three lagoons. Beneficial and detrimental effects of artificial aeration systems are discussed. Unsuccessful reproduction by adult carp in the aerated lagoons indicated that the adults were severely stressed and failed to reproduce or that environmental conditions did not favor survival of the zygotes. The survival and growth of carp fingerlings in the MD lagoon was poor in comparison to that in unpolluted Illinois ponds. At present the greatest potential for fish culture in concentrated swine waste lagoons seems to be the biological control of insect pests. Either manual or herbicide removal of flooded vegetation from the shoreline of waste lagoons may represent a practical method of mosquito control. Applications of Flit MLO and malathion during 1972 suppressed mosquito larvae populations for about one week. (Penrod-East Central)

## 2767-A11, C3

### BACTERIAL AND FUNGAL FLORA OF SEAGULL DROPPINGS IN JERSEY,

Jersey General Hospital, St. Helier (England)
J. Cragg and Y. M. Clayton
Journal of Clinical Pathology, Vol. 24, No. 4, p. 317-319, 1971. 12 ref.

Descriptors: Animal wastes (Wildlife), Bacteria, Fungi, Waste identification, E. coli, Streptococcus, Yeasts, Salmonella, Shigella, Seashores, Sampling, Laboratory tests, Gulls.
Identifiers: Seagull, Mycology, Jersey.

In Jersey 106 fresh and 122 dried seagull droppings were obtained and studied locally and in London for the presence of bacteria and fungi of potentially pathogenic nature. There were no salmonella or shigella bacteria isolated from the two groups but there was a high proportion of Candida albicans obtained from the fresh material (21.7 per cent) and only 1.6 per cent from the dry faeces. Cryptococcus neoformans and Histoplasma capsulatum were not found in either dry or fresh droppings. The normal bacterial and fungal flora of the seagull was established and it is considered that the C. albicans in fresh gull droppings would not materially increase albicans infections in man. (Bundy-Iowa State)

## 2768-A7,C1,C2,C3,D3,E1

### CHARACTERISTICS OF CHICKEN WASTES AND DISPOSAL BY LAGOONING,

C. R. Wieting
Unpublished M.S. Thesis, Civil Engineering Department, South Dakota State College, 1964, 64 p. 7 fig, 15 tab, 33 ref.

Descriptors: Physical properties, Chemical properties, Biological properties, Poultry, Lagoons, Waste disposal, Odor, Sampling, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen.

The purpose of this research was to determine characteristics of fresh chicken manure so that adequate treatment and disposal systems could be designed. Another research objective was to examine and evaluate an existing poultry manure lagoon's ability to stabilize organic chicken wastes. The following conclusions were based on observations and calculations made while evaluating the anaerobic lagoon used for chicken manure disposal. (1) An anaerobic lagoon should be designed to provide a minimum of 10 to 15 cubic feet of volume per chicken. (2) The depth of an anaerobic lagoon should be at least three feet. An adequate water supply must be available for maintaining this depth. (3) Offensive odors are prevalent when uncovered manure solids project above the lagoon's water level, but nuisance odor levels are practically non-existent during the major part of the summer. (4) Good mixing action of chicken wastes at the point of discharge to the lagoon is essential. (5) Solids buildup to the extent of threatening the useful life of a lagoon does not appear to be a major problem with proper solids dispersion. (Merryman-East Central)

## 2769-A4, A5, E2

### THE DISPOSAL OF INTRACTABLE INDUSTRIAL AND AGRICULTURAL WASTES–CONCLUSION,

Effluent and Water Treatment Journal, Vol. 10, No. 3, p. 147-149, March 1970.

Descriptors: Agricultural wastes, Industrial wastes, Water pollution, Waste disposal.
Identifiers: Gravel pits, Land disposal.

Past disposal of intractable wastes has been founded on the short haul of wastes from source to the nearest available tip site. The disposal of wastes to ground was, still is, and will be for a considerable time in the future, the cheapest method of disposal. Some of the existing gravel pit sites suffer from the shortcoming of not having impermeable bottoms, and most suffer the disadvantage of having impermeable sides. These pits could feasibly be rendered fit for waste disposal if the permeable bottoms and/or sides are sealed with clay or other impervious material. Ground disposal methods' greatest success will be achieved when four requirements are met. Firstly, the site used must not result in the transfer of polluting matter into ground or surface water. Secondly, the site should be dry. Thirdly, circumstances must exist or be provided so that liquid wastes disposed of can be absorbed in solid material to prevent any significant accumulation of waste liquor on the site. Fourthly, the site should be remote from dwellings and public open spaces. The best site for ground disposal is marshland area, founded on impervious soil where domestic refuse has been previously dumped. The second best site is the clay pit. Another method of disposal is application on agricultural land. (Cartmell-East Central)

## 2770-B1, C1, D1

### DRYING CHARACTERISTICS OF FULLY EXPOSED FORMED POULTRY EXCRETA,

T. M. Midden
MS Thesis, Agricultural Engineering Department, University of Kentucky, 1972, 60 p. 17 fig, 10 tab, 32 ref.

Descriptors: Poultry, Drying, Moisture content, Equations, Temperature.

Identifiers: Excreta, Crusting characteristics, Thin-layer drying constant.

Thin-layer drying equations were used to describe the drying characteristics of formed poultry excreta. Tests were conducted in a range of drying air temperatures from 100 degrees to 220 degrees F and with cylinders of manure from .339 to 1.056 inches in diameter. The crusting characteristics of the formed cylinders of manure were determined for drying air temperatures from 500 degrees to 950 degrees F. It was determined that a crust can be formed on the surface of a cylinder of poultry manure when the cylinder is exposed to high temperature drying air. The time required to form a stable cylinder increases with increasing cylinder diameter and decreases with increasing temperature. (Cartmell-East Central)

2771-A2, B1, F1, F2.

### ECONOMIC IMPACT OF ENVIRONMENTAL QUALITY LEGISLATION ON CONFINED ANIMAL FEEDING OPERATIONS IN OKLAHOMA,

G. R. Cross
MS Thesis, Oklahoma State University, Stillwater, July, 1971, 95 p. 3 fig, 40 tab, 37 ref.

Descriptors: Economic impact, Legislation, Confinement pens, Oklahoma, Costs, Legal aspects, Cattle, Lagoons, Poultry, Dairy industry, Agricultural runoff.
Identifiers: Oklahoma Feed Yards Act of 1969, Environmental Quality, Technical aspects, Swine, Land spreading.

A study was undertaken to analyze the economic impact of the Oklahoma Feed Yards Act of 1969 on confined animal feeding operations in Oklahoma. Specific objectives included examination of (1) technical (2) legal, and (3) economic aspects of the passage of the Oklahoma Feed Yards Act of 1969 as related to confined feeding and waste handling. A sample of confined animal feeding operators was drawn from a list of the registered feed yard operators of Oklahoma. These managers were contacted for an interview to obtain the data for this study. Maps and other secondary sources were used to augment these data. After analyzing the data gathered, the author concluded that the pollution problem from confined animal feeding is not as great as the raw numbers of animals would indicate. Another conclusion which this study supported is that legislators must consider the effect of any legislation upon the group to be controlled. The study revealed that most of the effect of the Feed Yards Act was on the fixed costs of the feed yards and that these costs probably could not be passed on to the consumer, but must be absorbed by the feeding operation.*Recommendations are given for feeding operations, and for further research and study. (Cartmell-East Central)

2772-A2,B2,B3,E2,F1,F2

### ECONOMICS OF ALTERNATIVE WASTE MANAGEMENT SYSTEMS COMPLYING WITH POLLUTION CONTROL REGULATIONS ON BEEF FEEDLOTS IN SOUTHWESTERN MINNESOTA,

C. L. Pherson
Unpublished PhD Dissertation, Department of Agricultural and Applied Economics, University of Minnesota, December, 1973, 152 p. 5 fig, 37 tab, 72 ref.

Descriptors: Economics, Regulation, Legal aspects, Feedlots, Cattle, Minnesota, Agricultural runoff, Costs.
Identifiers: Waste management, Land disposal.

The objectives of this study were to determine the effects of complying with pollution control regulations on the cost and design of a beef feedlot. Other factors studied were: (1) the most "profitable" beef waste management-housing system, (2) the optimal time schedules for beef waste handling operations, (3) the effects of system choice on crop selection and field operation time scheduling, and (4) the effect of Set-Aside or rotating disposal field on farm-feedlot profitability. Study data showed that there may be substantial indirect costs of switching to waste handling systems which comply with pollution control regulations. Both operating expenses and per head investment are greater for small lots than for large capacity facilities. Optimum net returns were provided in most instances by liquid waste handling in cold slotted floor confinement housing. Drylot, scrape barn, and open lot rank in that order with respect to returns to all labor. Returns to all labor will be reduced by using a small rotating disposal field of uncropped land each year, but the reduction is small. The study presented methods for cost reduction in relation to runoff control and other waste management systems. (Penrod-East Central)

2773-A4, B1, E1

### THE EDITOR'S NOTEBOOK: ABOUT DISCHARGE REGULATIONS,

The Catfish Farmer, Vol. 6, No. 1, p. 7-8, January, 1974.

Descriptors: Catfishes, Runoff, Permits.
Identifiers: Environmental Protection Agency, Discharges, Requirements.

Most catfish farming is exempted under new EPA regulations. Those facilities not subject to NPDES requirements are: (1) closed ponds with discharges only during annual harvesting or during periods of excess runoff, (2) facilities where discharges occur less than 30 days a year, and (3) facilities where flow is continuous but total number of pounds produced per year is less than 20,000 pounds. (Cameron-East Central)

2774-A8, B2, C2, E2

### EFFECTS OF OVERLOADING SWINE EFFLUENT ON TALL FESCUE, REED CANARYGRASS, AND CORN,

P. F. Duffner
MS Thesis, Agronomy Department, University of Illinois, Urbana-Champaign, 1974, 90 p. 28 fig, 6 tab, 60 ref.

Descriptors: Effluent, Fescues, Forages, Crop response, Nutrients.
Identifiers: Swine, Application rates, Corn, Soil pH.

To determine the effects of overloading swine manure on cropland, swine manure effluent was applied in high rates to tall fescue and reed canarygrass in a greenhouse experiment. Equivalent amounts of a commercial fertilizer were also applied. Clippings were taken from the plants at 30-day intervals and analyzed. Soil samples were also taken. Factors checked in determining the effects that rate or source of nitrogen has on the plants were: dry yields, tissue nitrate concentrations, soil pH, phosphorus, potassium, and nitrate. As shown by the data collected, plant growth was hindered by applications of effluent over 672 kg N/ha; however, this appeared to diminish with time so that yields could be maintained through split applications. Levels of nitrate high enough to be toxic to animals accumulated in the fescue and canarygrass receiving effluent, although no accumulation appeared in plants on which commercial fertilizer was used. High rates of effluent were also applied in a field experiment to corn. Grain production, tissue nitrate, soil pH, phosphorus, potassium, and nitrate were examined. As the rate of effluent increased, the nitrate concentrations in the cornstalks also increased. Checks were made on the soil at depths of 0 to 15 cm, 15 to 30 cm, and 30 to 90 cm, with no changes in soil pH. The nitrate movement downward was negligible. Irreversible plant damage was done by effluent applications of over 940 kg N/ha, although there seemed to be no appreciable amount of pollution potential at this rate. (Sanders-East Central)

2775-A6, C1, D2, F1

### EVALUATION OF PHYSICAL PROPERTIES OF PIG MANURE,

Department of Chemical Engineering, University of Newcastle Upon Tyne
J. R. Backhurst, and J. H. Harker
Journal of Agricultural Engineering Research, Vol. 19, p. 199-207, 1974. 5 fig, 9 tab, 8 ref.

Descriptors: Physical properties, Evaluation, Incineration, Density, Viscosity, Filtration, Slurries, Drying, Moisture content, Odor, Costs.
Identifiers: Swine, Calorific value.

The objective of this study is to evaluate, with emphasis on density, viscosity, and calorific value, the physical properties of pig manure during the course of feeding trials. The feeding trials lasted for 14 weeks. Over this trial period, the densities of the urine and separated feces varied only slightly and mean values of 1016 and 1130 $kg/m^3$ were obtained respectively. The calorific value of the dried feces was found to be 17.9 MJ/kg, which will contribute significantly in any incineration operation. The mean viscosity was determined to be 1.10 $mNs/m^2$ for the trial period. Technical scale tests on filtration and drying of slurries are reported with mean transfer rates of $7.0 \times 10^{-5}$ $kg/m^2$ and $2.2 \times 10^{-4}$ $kg/m^2$ respectively. The study indicated that incineration of waste could be within the bounds of a viable commercial proposition, especially taking into account the decrease in total operation costs with reduced moisture content resulting from the contribution made by the calorific value of the dried feces. Long term possibilities indicate that incineration as the sole complete disposal method may prove to be the ultimate solution to the problems involved. (Penrod-East Central)

2776-B1, D2, E3, F1

### ENERGY CRISIS FUELS RESEARCH TO DEVELOP ALTERNATIVE POWER SOURCES,

Associate Editor of EDN
J. Bond
EDN Magazine, Vol. 19, No. 3, p. 24-26, February 5, 1974. 2 fig.

Descriptors: Energy, Fuels, Cattle, Gases, Costs.
Identifiers: Manure, Gasification, High-power fuel cell, Solar power.

The energy crunch has generated a great deal of interest in more efficient methods of power production. Three methods were considered in this report. They are: high-power fuel cell, solar power, and cow manure. The first method is eminently practical and not far from realization. The second is a strong contender but needs a lot of effort. The third method might appear impractical at first, but it has been worked out rather carefully and the economics look very good. Hydrogasification of cattle manure could provide large quantities of high-quality pipeline gas. With feedlots containing 50,000 or more head of cattle, reasonably large gas-production plants could be built nearby to eliminate transportation costs. The method selected for gasification is the Hydrane Process. Cost projections indicate that the gas prices (based on free manure) would be reasonable—about 41 cents/MBtu for a plant that has a manure rate of 690,000 lbs/hr. (Cameron-East Central)

2777-A5, C2

### GROUND-WATER CONTAMINATION BY DISSOLVED NITRATE,

Geology Department, Missouri University, Columbia
W. D. Keller and G. E. Smith
Presented at 164th Meeting of Geological Society of America, Miami, Florida, 27 p. 3 fig, 3 tab.

Descriptors: Nitrates, Fertilizers, Geochemistry, Missouri, Surveys.
Identifiers: Groundwater contamination, Farm wastes.

This report is concerned with a brief comment on the geochemistry of the $NO_3$ ion and a progress survey of high-nitrate subsurface water in Missouri. Nitrates in Missouri subsurface waters were investigated by collecting water from wells and springs. More than 5,000 water samples were collected and analyzed. Approximately 42 per cent of the samples ranging from 12 to 75 per cent of the samples from individual counties, contained over 5 ppm nitrogen. The dominant source of water-pollutant nitrate in Missouri water table was found to be nitrogenous waste material from farm feed lots. Heavy application of nitrate fertilizers on highly permeable, alluvial soils, may contribute to the nitrate content of water table wells. (Cartmell-East Central)

## 2778-A2, B1, F4
### A HANDBOOK FOR ESTIMATING THE POLLUTION POTENTIAL OF BEEF, DAIRY, SHEEP AND SWINE FEEDLOTS IN THE NORTH CENTRAL REGION,

Agricultural Engineer, 724 East First Street, Fairmont, Minnesota.
R. L. Mensch
Project Report for Consulting Work Performed for the Farm Structures Division, Agricultural Engineering Department, University of Illinois, Urbana, June, 1971, 29 p. 18 fig.

Descriptors: Feedlots, Livestock, Agricultural runoff, Cattle, Dairy industry, Sheep, Climatic data.
Identifiers: North Central U.S., Pollution potential, Swine.

The primary objectives in preparing this handbook are: (1) present procedures so that non-engineers can make on-site evaluation of a feedlot's pollution potential, (2) simplify mathematics so they can be performed without a computer or slide rule, and (3) reduce the number of instruments needed in securing field data to a minimum. A literature review was conducted to pull together the various procedures and equations of evaluating a feedlot's pollution potential in various order to provide a continuous evaluation of the system, going from one component to the next. Selected references are cited. Evaluation of a feedlot must include climatic data as well as other factors such as: number of animals, type of animals, ration, percentage of time during the year that the feedlot is in use, feedlot area, lot slope and slope length, and feedlot management. All factors are compiled into a two page worksheet for the computation of feedlot runoff pollution. (Penrod-East Central)

## 2779-B3, C2, D3, E2, F1
### HIGH RATE COMPOSTING OF MUNICIPAL REFUSE AND POULTRY MANURE,

Department of Microbiology, Dunedin, New Zealand
R. G. Bell and J. Pos
Canadian Agricultural Engineering, Vol. 15, No. 1, p. 49-53, June, 1973. 7 fig, 6 tab, 6 ref.

Descriptors: Composting, Municipal wastes, Farm wastes, Poultry, Costs, Recycling, Waste treatment, Waste disposal, Fertilizers, Ammonia, Economics.
Identifiers: Manure.

The work reported here was undertaken to demonstrate the feasibility of composting broiler manure in association with refuse to produce a soil-conditioning agent without the evolution of copious quantities of ammonia. The composting facility consisted of a high-rate composter housed under the same roof as ancillary equipment for the sorting, comminution and blending of municipal refuse with broiler chicken manure. Municipal refuse was sorted to remove metal, glass, plastic and rags, and then passed through a hammer mill. The shredded refuse was then moistened and blended with broiler manure in the ratio of 5:4 by weight. This mixture was treated in a high-rate composting unit for 8 days and then discharged to a stockpile and allowed to mature. The mature compost direct from the stockpile is being evaluated as an aid to the restoration of vegetative cover on a former gravel pit site and reground compost is being tested by the horticultural industry. The cost of producing compost from poultry manure and municipal refuse without presorting amounted to $22.66 per ton. (Cartmell-East Central)

## :2780-A6, A7, B1, D1
### AN INVESTIGATION OF ODOUR CONTROL FOR SWINE BUILDINGS,

J. C. Abercrombie
MS Thesis, University of Guelph, Guelph, Ontario, Canada, 1971, 78 p. 15 fig, 13 tab, 31 ref.

Descriptors: Odor, Confinement pens, Filtering, Dusts, Chemical properties.
Identifiers: Odor control, Swine buildings, Air washer.

An investigation was undertaken with the following objectives: 1. To determine if odours in the exhaust air of swine buildings are carried by particulate materials. 2. To determine which size of particle is most responsible for transporting odours from swine buildings. 3. To examine presently accepted methods of particulate collection and evaluate their usefulness for removing the particulate material from the exhaust air from swine buildings. 4. To determine whether filtering of the exhaust air has any significant use as a method of controlling odour emissions from swine buildings. 5. To investigate the effect of weather conditions and distance on the dispersion of pollutants from a swine building. The particles collected by both the vacuum and electrostatic processes were odorous. The most important fraction of the particulate material responsible for transporting obnoxious qualities appeared to be the fraction between 5 and 20 microns in size. It was found that odours carried in an air-stream could be removed by filtering. In descending order, the following systems were found to be most efficient in removing odour from the air stream: viscous impingement filter plus electrostatic precipitator plus activated carbon filter; viscous impingement filter; dry filter plus electrostatic precipitator; dry filter. (Cartmell-East Central)

## 2781-A2,A4,B2,C1,C2,E2
### AN INVESTIGATION OF THE POLLUTIONAL CHARACTERISTICS OF RUNOFF FROM TWO FEEDLOTS,

P. E. Thormodsgard
M.S. Thesis, South Dakota State University, Brookings, 1970, 74 p.

Descriptors: Agricultural runoff, Feedlots, South Dakota, Sampling, Pollution, Suspended solids, Nitrogen, Phosphorus, Oxygen, Snowmelt, Rainfall.
Identifiers: Land disposal.

The trend toward larger numbers of animals in feedlots has resulted in the concentration of their wastes. Consequently waste management has become a major problem. The general objective of this investigation was to explore the pollution characteristics of runoff from two feedlots in eastern South Dakota. The specific objectives were: (1) To determine the quantity and quality of feedlot runoff from the Animal Nutrition unit and the Dairy Research and Production unit at South Dakota State University, (2) To investigate the spring feedlot runoff resulting from snowmelt as well as the runoff produced by spring rainfall, (3) To determine the pollutional characteristics attributable to the suspended matter in the feedlot runoff in order to assess the effectiveness of settling in reducing the waste concentrations in feedlot runoff. It was concluded from the investigation that: (1) High concentrations of total and suspended solids, nitrogen, phosphorus, and oxygen-demanding material were present in the feedlot runoff, (2) The snow removal operation in the beef pens and the dairy confinement lot reduced the volume of snowmelt runoff from each unit, (3) Population equivalent values of the total animal waste load produced on the two feedlots were not a valid assessment of the actual pollution attributable to the runoff from these units, (4) The water pollution resulting from the feedlot runoff from the two units was probably negligible during this investigation, (5) The centrifuging procedure was effective in reducing the waste concentrations of the runoff samples, (6) Diversion of feedlot runoff onto cropland may be a satisfactory means of handling feedlot runoff in some situations. (Battles-East Central)

## 2782-A3,A5,A8,C2,E2,F6
### LAND SPREADING OF MANURE FROM ANIMAL PRODUCTION UNITS,

Department of Agricultural Engineering, The University of Newcastle upon Tyne
J. R. O'Callaghan, K. A. Pollock, and V. A. Dodd
Journal of Agricultural Engineering Research, Vol. 16, No. 3, p. 280-300, September, 1971. 6 fig, 13 tab, 22 ref.

Descriptors: Computer models, Waste disposal, Fertilizers, Cattle, Water pollution.
Identifiers: Land disposal, Loading rates, Manure, Swine, Hydraulic loading, Chemical loading.

A computer simulation model has been developed to determine manure output for a group of pigs as a function of diet. The results of this model are incorporated into a second model designed to simulate land spreading of the manure. One of the factors to be considered in land spreading is the hydraulic loading of the soil; this is assessed by comparing actual evapotranspiration with historical rainfall figures and allowing the manure to make up any soil moisture deficiency. Chemical loading is determined by assessing the levels of nitrogen, potassium, and phosphorus that will be removed by the crop or fixed in the soil. Any excess applied over this figure will result in groundwater or runoff contamination. Because of increased soil saturation and decreased organic activity in cold weather, spreading during winter months is not advisable. The farmer should never apply more slurry to the soil than can be immediately absorbed. Crops also affect the maximum permissible chemical loading; intensive grass production permits the maximum loading. To plan a waste disposal system, levels of manure output and its chemical composition must be established. The hydraulic and chemical loading maximums for each field and each crop will allow the minimum acreage required for waste disposal to be calculated. By avoiding the need to purchase fertilizer, the farmer can realize cash value from his manure. For example, if a farmer fattens 5,000 hogs per year, the total cash value of the nitrogen, potassium, and phosphorus content of the manure would be 5000 pounds sterling, with spreading costs of about 1,700 pounds sterling. (Solid Waste Information Retrieval System)

## 2783-A8, C2, E2
### MANURE-HANDLING CAPACITY OF SOILS FROM A MICROBIOLOGICAL POINT OF VIEW,

Department of Environmental Biology, Guelph University, Guelph, Ontario

J. B. Robinson
Presented at Canadian Society of Agricultural Engineers Conference, Charlottetown P.E.I., June 27, 1972, Paper No. 72-210, 18 p. 4 fig, 18 ref.

Descriptors: Soils, Microbial degradation, Nutrients, Phosphorus, Nitrogen, Pathogens.
Identifiers: Manure.

The criterion for handling capacity of a soil may be taken to be "the ability of the soil microflora to assimilate waste without permitting excessive leakage of nutrients and other undesirable components from the system." This ability is affected by temperature, moisture content, degree of aeration, pH, and initial microbial population. The components of most concern are carbon, phosphorus, nitrogen, and pathogenic organisms. Of these, nitrogen is usually the most critical. Due to the complexities of microbial conversions of nitrogen in mineralization, nitrification, and denitrification, generalizations are frequently erroneous and many contradictory results have been reported in the literature. (Whetstone, Parker, Wells-Texas Tech University)

## 2784-B4, E2, F1, F6

### REGIONAL MANAGEMENT OF ANIMAL MANURES–A MODEL FOR COLLECTION, STORAGE LOCATION AND DISTRIBUTION,

Agricultural Institute, Dublin
V. A. Dodd, D. F. Lyons, and J. R. O'Callaghan
Journal of Agricultural Engineering Research, Vol. 19, p. 233-244, 1974. 1 fig, 2 tab, 4 ref.

Descriptors: Mathematical models, Waste storage, Economics, Systems analysis, Poultry.
Identifiers: Land spreading, Swine, Collection.

It is proposed that a centralized storage facility should be provided for a group of pig and/or poultry units. The manure that is collected and brought to the central store can be disposed of by spreading on land in a separate operation. A mathematical, analytical model is constructed to determine the best place to locate the central store, and to determine the number of tanker wagons needed to collect and spread the manure. The model was applied to a specific region containing 58 pig fattening units. Results showed that the system may be economically attractive, having as additional advantages the minimization of pollutional hazards and the relieving of the pig or poultry farmer of the task of manure management. (Solid Waste Information Retrieval System)

## 2785-D2, E3, F1

### AGRICULTURAL WASTES--AN ENERGY RESOURCE OF THE SEVENTIES,

Bureau of Mines, U.S. Department of the Interior, Washington, D. C.
William L. Crentz
Presented at the World Farm Foundation Symposium, Anaheim, California, December, 1971, 25 p. 2 fig, 8 tab, 15 ref.

Descriptors: Recycling, Energy, Fuels, Gases, Oils, Autoclaves, Costs, Cellulose.
Identifiers: Pyrolysis.

The Department of Interior's Bureau of Mines has developed two processes for utilizing the cellulose from farm and urban wastes: pyrolysis and autoclaving. In the pyrolysis process, wastes are passed through a high temperature (200-900 degree C) retort system. A recovery train removes tar and heavy oils, a lighter oil, an aqueous product and tar fog and vapor mists. The remaining gases pass through scrubbers, an acid tower, and an alkali wash before emerging as a usable product. Pollution from the plant is negligible. For a large plant, the costs of pyrolysis are much less than the costs presently being paid by cities for incineration ($8 to $12 per ton) or landfill ($6 to $8 per ton). In the autoclaving process, the wastes are converted to low-sulfur oils by treatment with carbon monoxide and water under high pressures and temperatures. The most likely end use of this fuel oil would be for generation of electricity. (Cannon-East Central)

## 2786-A2,B2,D3,F1

### TREATMENT AND DISPOSAL OF ANIMAL WASTES,

Cornell University, Ithaca, New York
R. C. Loehr
Industrial Water Engineering, Vol. 7, No. 11, p. 14-18, November 1970. 3 fig.

Descriptors: Waste treatment, Waste disposal, Animal wastes, Aerobic treatment, Anaerobic conditions, Drying, Agricultural runoff, Nitrification-denitrification.
Identifiers: Oxidation ditch, Holding tank, Composting.

Intensive livestock production methods are becoming big pollution problems. Nine animal waste treatment and disposal methods are discussed. System one is daily disposal on the land without a holding tank and is common with many dairy operations. An aerobic unit is substituted for the holding tank in System two. In an attempt to reduce the size of the aerobic unit, System three incorporates an anaerobic unit which can act as a surge tank and a repository for the heavier solids. Systems four and five are in-house ditches. System number four, an in-house oxidation ditch system, offers the advantage of inexpensive construction since it is a part of the confinement building. System five incorporates a non-aerobic in-house system. System six separates the semi-solid wastes from the washwaters at the source. Systems seven-nine are based on the drying and composting of animal wastes but require a market for the product. These markets are not yet available on a general basis. The above systems will remove most of the organic-oxygen-demanding material but not the inorganic nutrients. Two engineering techniques are available to reduce the quantity of nitrogen in the wastes at the production site. These are nitrification-denitrification and ammonia release. Systems to handle runoff are discussed. (Kehl-East Central)

## 2787-B3, C2, D3

### WINTER HIGH RATE COMPOSTING OF BROILER MANURE,

Department of Environmental Biology, University of Guelph, Guelph, Ontario
Bell, R. G. and Pos, J.
Canadian Agricultural Engineering, Vol. 13, No. 2, p. 60-64, December, 1971. 10 fig, 2 tab, 5 ref.

Descriptors: Winter, Farm wastes, Waste treatment, Poultry, Aeration, Temperature, Weather, Nitrogen, Carbon.
Identifiers: Composting, Manure, Broilers.

An acrated horizontal silo type composter was constructed to test the feasibility of high rate composting of broiler manure during the winter months. It was concluded that high rate composting is possible outside during the winter when supplementary heating equipment is used. It was hampered by snow buildups and freezing rain which necessitates a roof for maximum efficiency. A forced aeration system proved to be necessary for high rate composting, and ideally the composter should be loaded daily. The use of ground garbage will increase the carbon to nitrogen ratio and produce a better compost. The compost itself proved to be reasonably consistent, but several modifications and adjustments are necessary before the high rate composter could be considered successful. (Russell-East Central)

## 2788-B3, D3

### THE FLOW OF SOLID WASTES IN PIPELINES,

Compost Science, Vol. 8, No. 2, p. 11, Autumn 1967-Winter 1968. 1 tab.

Descriptors: Solid wastes, Hydraulic transportation, Pipelines, Municipal wastes.
Identifiers: Feedlot wastes, Composting.

Among the research projects now being supported under the Solid Waste Program of the Public Health Service is a study by Dr. Iraj Zandi of the University of Pennsylvania who is exploring the pipeline collection and transportation of solid wastes. Despite the potential of solid pipeline systems, the inability to predict accurately the headlosses that will occur under an assumed condition has been one of the factors impeding the development and widespread use of hydraulic transportation. Experiments have shown that ground-up municipal refuse could be mixed with a small amount of water from the city sewer system and pumped out of the city. Pipelines would only have to be 2-in. in diameter to carry the wastes of a town with a population of 10,000 to 15,000. In the future, magnetic and centrifugal sorting devices may be used to separate metals, glass and plastics for salvage. The remaining organic material could be mixed with sludge from sewage treatment plants and manure from feedlots, and the entire mixture composted. A slurry of 40 per cent solid wastes may be a good input to a composting system. Industrial installations of pipeline transportation in the U.S. and Europe are listed. (Solid Waste Information Retrieval System)

## 2789-A11, C3, E2

### EFFLUENT SPRAY DISEASE RISK,

Senior Research Officer (Pollution), and Scientific Liaison Officer, of the Meat Industry Research Institute, Hamilton, New Zealand
C. F. Denmead and G. R. Bentley
New Zealand Journal of Agriculture, Vol. 125, No. 4, p. 23, October, 1972. 1 fig.

Descriptors: Health, Diseases, Salmonella
Identifiers: Spray irrigation, Cattle manure, New Zealand.

This article discusses the potential health hazards involved in spraying microorganisms from cattle dung around pastures. Salmonella is one of the dangerous organisms which can be found in cattle dung. In the case of spray irrigation this material is diluted and sprayed thinly over a large area. Whether or not an animal becomes infected depends on the number of live organisms ingested. In the case of a milk infection, milk production can be reduced. A serious infection could mean complete loss of production or the death of the animal. The following measures will assist in stopping the spread of infection: irrigating on ploughed ground; minimizing spray drift; and waiting a few months before using a sprayed pasture. By careful management of cowshed waste disposal, farmers can reduce the spread of cattle diseases. (Solid Waste Information Retrieval System)

## 2790-A11, C2

### TOXICITY OF NITRITE TO CHANNEL CATFISH,

Fisheries Research Laboratory and Department of Zoology, Southern Illinois, University, Carbondale.
M. Konikoff
The Progressive Fish-Culturist, Vol. 37, No. 2, p. 96-98, April, 1975. 1 fig, 3 tab, 13 ref.

Descriptors: Catfishes, Nitrites, Ammonia, Toxicity.

A study concerning the toxicity of nitrite, an intermediate compound formed during the biological oxidation (or nitrification) of ammonia (a major waste product of fishes), is reported in terms of toxic effects on channel catfish. Channel catfish, which had been held for at least four weeks in raceways, were added to five aquariums filled with 40 liters each of dechlorinated tapwater. The fish were added at an average density of 264 grams per aquarium. Average fish weight was 40 grams. The fish were acclimated for 24 hours. Then appropriate amounts of sodium nitrite solution were added slowly to the aquariums. Groups of 6-10 fish were exposed to concentrations of 15, 20, 25, 30, and 35 mg/l of $NO_2$ for 4 days. This was repeated until 28 fish had been exposed to each concentration. Other groups of fish were exposed to 5, 10, 40 and 45 mg/l of $NO_2$ with fewer replications. Dead fish were removed at 24, 48, 72, and 96 hours. Temperature, dissolved oxygen and pH were measured. The median tolerance limit for each time period was calculated from a regression equation which was determined for the log of the nitrite concentration and the per cent fish surviving. The easiest method of confirming nitrite toxicity is to inspect the color of the fish's blood, which will become chocolate-brown under toxic conditions. The wide range of tolerances exhibited by fishes to nitrite poisoning indicates that nitrite might be used as a selective fish toxin. (Merryman-East Central)

## 2791-B2, C1, C2, C3, D3

### THE TREATMENT OF PIGGERY WASTES,

L. Littlejohn (ed)
The Treatment of Piggery Wastes, Scottish Farm Buildings Investigation Unit, North of Scotland College of Agriculture, June, 1975, 66 p. 28 fig, 15 tab, 21 ref.

Descriptors: Waste treatment, Waste disposal, Anaerobic lagoon, Anaerobic digestion.
Identifiers: Swine, Scotland, Below-house oxidation ditch, Surface aerator, Oxidation ditch.

Treatment and disposal of piggery wastes in Scotland is not without problems. The ideal method of animal wastes disposal is to recycle them by application to the land. But because of the complexities of modern agricultural production and pressures from non-agricultural sectors of the community there are increasing numbers of situations arising in which it may be desirable to put animal wastes through some form of treatment before disposal, whether to the land or elsewhere. The objectives of such treatment may range from simple deodorization to the production of a final product acceptable by sewage authorities or river boards. This publication describes the problems that piggery wastes present. A description of the physical, chemical and biological properties of piggery wastes is given. Field scale experimentations with (1) Below-house oxidation ditch, (2) Surface aerator, (3) Anaerobic lagoon, (4) Independent oxidation ditch, and (5) Anaerobic digester are presented. Results of development work utilizing these treatment systems is reported. (Merryman-East Central)

## 2792-A8, C2, E2

### THE EFFECT OF INCORPORATED ANIMAL MANURE AND pH ON THE SOLUBILITY OF SOIL MANGANESE,

T. M. Taukobong
MS Thesis, Tuskegee Institute, May, 1973, 79 p. 26 fig, 14 tab, 73 ref.

Descriptors: Manganese, pH, Plant response, Toxicity, Soil analysis, Lime.
Identifiers: Manure, Land disposal, Rye, Millet.

An investigation was conducted to study the relationship of pH and animal manure to the solubility of manganese in the soil, and to determine if high application rates of manure to the soil would result in manganese toxicity in plants. Several studies were conducted. In one such study, lime was added to soil samples to give pH values from 4.2 to 6.0 and in a second study, manure of 0 to 120 tons per acre were added to the soil. The soils were incubated, sampled, and analyzed for soluble, exchangeable and easily reducible manganese. In another study, the solubility of manganese was studied as indicated by its uptake in rye and millet. The following conclusions were drawn from these studies: (1) Manure addition to soil results in drastic change of soil pH. (2) The action of manure in causing manganese retention may be two-fold; partly due to the increase in pH and partly due to the complexing of the metal. (3) Exchangeable manganese, and to a lesser extent water soluble manganese, seems to be the fraction of soil manganese most susceptible to changes in pH and the amount of manure in the soil, while the easily reducible manganese does not readily respond to these changes. (4) When added to the soil in conjunction with lime, manure tends to reduce the drastic effect of lime on soil manganese. (5) There is no evidence that addition of manure could result in production of toxic amounts of manganese in the soil. (Sanders-East Central)

## 2793-A11, E3, F1, F2

### CHICKEN LITTER COW FEED,

R. Carmody
The Farm Quarterly, Vol. 19, p. 52-53, 92, 94, Fall, 1964. 1 fig.

Descriptors: Feeds, Litters, Poultry, Cattle, Maine, Performance, Costs, Economics, Legal aspects, Scours.
Identifiers: Refeeding.

Under drastic cost conditions, Maine farmers are forced to find a cheap feed so they can stay in production. Some think that chicken litter may be the answer. Results have revealed that by incorporating chicken litter into cattle feed, birth weights may be increased and calf scours may be reduced. However, care must be taken to keep the feed dry, as it becomes extremely unpalatable when wet. Dr. Brugman of the University of Maine is conducting tests on the utilization of poultry litter in cow feed. Although he isn't ready to release the data on his digestion trials, he did state that digestibility of the material was remarkably high. Feed samples made from laying-house litter have lignin content slightly under the 4 per cent figure. The doctor also stated that two things are important in the use of the litter and they are: (1) energy must be added to the ration, and (2) thorough mixing is essential. He further stated that although research data is still needed on the subject, chicken litter shows real promise as a feed for beef cow herds and for dairy replacements. Some conflict with Maine law may arise in feeding litter to producing dairy cows so its best use may be in raising replacement stock. One other problem was noted and that was the removal of metal trapped in the litter. One study showed that the primary cost in going to this feed was the purchase of a Gehl protable hammer mill.and mixer in which the feed may be thoroughly mixed, and which can be hauled to the field and unloaded into the big feeders. (Penrod-East Central)

## 2794-A8, B3, C2, E2

### SOLIDIFICATION OF SLUDGES WITH PORTLAND CEMENT,

Department of Civil Engineering, Clarkson College of Technology, Potsdam, New York
E. A. Cassell and T. W. Walker
Journal of Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 96 (SA1), p. 15-26, February, 1970. 7 fig, 7 tab, 13 ref.

Descriptors: Poultry, Portland cements, Fly ash, Leaching, Phosphates.
Identifiers: Sewage sludge, Solidification, Soil conditioners.

A report was made on research to investigate the solidification of sewage sludge and chicken manure in a matrix of Portland cement and fly ash. It was suggested that the solidified matrix could serve as a controlled nutrient release soil conditioner. The rate of phosphate leaching from the matrix, the compressive strength of the matrix, and the time required for the mix to set were influenced by the fly ash to cement ratio, the sludge (or manure) to cement ratio, and the water to cement ratio. (McQuitty and Barber-University of Alberta)

## 2795-A6, A8, E2

### FINALLY A CREATIVE, PROFITABLE SOLUTION TO AGE OLD WASTE PROBLEM,

L. Richardson, Editor
Big Farmer, Vol. 44, March, 1972, 2 p. 5 fig.

Descriptors: Cattle, Municipal wastes, Odor, Crop response.
Identifiers: Swine, Land disposal.

Land disposal of hog, cattle, and urban sludge in the right proportions has eliminated odors in the operation of a project at Richmond, Illinois. Corn yields are reported to have increased from 40 bu to over 100 in three years. (Whetstone, Parker, and Wells-Texas Tech University .)

## 2796-A8, C2, E2

### THE DISPOSAL OF COPPER-ENRICHED PIG-MANURE SLURRY ON GRASSLAND,

Department of Soil Science, University of Aberdeen
T. Batey, G. Berryman and C. Line
Journal of the British Grassland Society, Vol. 27, No. 3, p. 139-143, 1972. 8 tab, 16 ref.

Descriptors: Copper, Slurries, Toxicity, Soils, pH.
Identifiers: Swine, Herbage.

Manure slurry from swine that have been fed copper-enriched diets was applied to land located at the National Institute of Research in Dairying at Shinfield. The slurry was applied in May, June, and July of 1966 at rates of 5000 gal slurry ac and 10,000 gal slurry ac. The soil in the slurry disposal area, as well as the herbage grown there, was analyzed for possible effects. Although copper levels increased in the soil, the levels varied in herbage and appeared to be affected by the rate of grass growth. It appears that there is little risk of copper toxicity following copper-enriched slurry applications; however, to avoid possible hazards from copper buildups in the soil, a maximum annual application of 8.5 lb/ac copper is recommended until more is known about the availability of copper in slurry to crops and grass. (Penrod-East Central)

## 2797-A2, B2, B3, F2

### MANAGEMENT AND CONTROL OF BEEF FEEDLOT WASTE,

Agricultural Research Service, U.S. Department of Agriculture.
O. E. Cross, and C. B. Gilbertson
Farm, Ranch, and Home Quarterly, Nebraska Agricultural Experiment Station, Lincoln, p. 20-21, Winter, 1969. 2 fig.

Descriptors: Feedlots, Cattle, Nebraska, Regulations, Agricultural runoff, Water pollution.
Identifiers: Detention ponds, Rainfall.

Feedlot owners are being given the legal responsibility for insuring that their operation does not contaminate Nebraska's water. The Water Pollution Control Council of the Nebraska State Department of Health has been charged with setting up regulations to maintain Nebraska's water quality. Since information on the most effective ways to dispose of feedlot waste was not available, the Nebraska Livestock Feeders Association and its Pollution Control Committee were given two years to research and develop information on which regulations could be based. Several projects are underway to determine the efficiency of several different systems of waste management. Four systems are discussed which examine several different aspects of feedlot waste management. These systems cover runoff collection and treatment, movement of solids on dirt lots, and various methods of loader cleaning. Rainfall, its duration and intensity is recorded for use in the analysis. (Penrod-East Central)

2798-A8, C2, E2

### EFFECT OF NITROGEN AND FARM YARD MANURE ON FINGER MILLET ELEUSINE CORACANA (L) GAERTN,

Department of Botany, Tamil Nadu Agricultural University, Coimbatore-641003, INDIA
P. Rangaswamy
Madras Agricultural Journal, Vol. 60, No. 8, p. 949-952, August, 1973. 2 fig, 3 tab, 6 ref.

Descriptors: Nitrogen, Farm wastes, Crop response.
Identifiers: Land disposal, Millet, India.

This study discusses the response of early (95 days and below) and short (95-115 days) duration finger millet varieties to the application of graded doses of nitrogen and farm yard manure. The trial was conducted at Millets Breeding Station, Agricultural College and Research Institute, Coimbatore during 1965-1968. The manurial trial was a failure during the 1967 monsoon season due to severe drought and incidence of pests and diseases. Among the millet varieties viz., CO.8, AKP.2, CO.10, and EC.4841, the strain CO. 10 and selection EC.4841 recorded 35.3 and 50.3 per cent higher yield than the standard strain CO.8. Early duration varieties recorded 24.1 per cent higher grain yield at 67.5 kg nitrogen level; beyond that there was a decline in yield. For the early duration finger millet varieties, the yield differences due to the application of farm yard manure were significant during the year 1968. Application of farm yard manure at 25 tonnes-ha caused a 9.1 per cent increase in grain yield over no farm yard manure treatment. The short duration varieties responded well to the application of graded levels of nitrogen even up to 112.5 kg nitrogen-ha. Interactions between different levels of nitrogen and farm yard manure and varieties were not significant in all the years and in combined analysis. (Penrod-East Central)

2799-A4. A7, D2, E3 100

### RETORTING FEEDLOT WASTES,

Science News, Vol. 102, No. 10, p. 153, September, 1972.

Descriptors: Feedlots, Organic wastes, Carbon, Fuels, Water pollution, Air pollution.
Identifiers: Retort system, Pyrolysis, Inert ash, Char, Water clarification, Soil conditioner, Texas Technological University.

A particularly serious problem in the area of water and air pollution is feedlot waste. Each steer produces 16 times the organic waste produced by a human being. If organic wastes enter waterways, they cause high biological oxygen demand; if they are incinerated, they cause air pollution. Researchers at Texas Technological University have developed a retort system which dries feedlot waste, then pyrolyzes it. The product is char, carbon and inert ash which can be used for water clarification, as fuel, or as a soil conditioner. If the system is scaled up to commercial size and automated, it would require only one or two men to operate. (Solid Waste Information Retrieval System)

2800-D2, D3, E3, F4

### FUTURE ENERGY SOURCES FOR TRANSPORTATION,

College of Engineering, Drexel University, Philadelphia, Pennsylvania
C. W. Savery
Traffic Quarterly, Vol. 26, No. 4, p. 485-499, October, 1972. 7 tab.

Descriptors: Energy, Recycling, Animal wastes, Municipal wastes, Hydrogen, Ammonia, Sludge digestion, Fermentation, Anaerobic digestion, Methane, Carbon dioxide, Alcohols.
Identifiers: Transportation fuels, Agricultural wastes, Pyrolysis, Hydrocarbons.

Natural energy resources are being consumed at a terrific rate. In 1960, approximately 20 per cent of the total energy consumed in the United States was consumed in transportation—126,000 Btu per capita per day. On one hand transportation fuel sources must be conserved and synthetic fuels produced. Two of these fuels would be hydrogen and ammonia. The third type of fuel would be produced by recycling waste trash, animal wastes, and crop residues. The pyrolysis of municipal refuse offers a possibility of producing fuels. It is estimated that 500 to 700 Btu per capita per day would be produced by recovering gas from the sludge digestion process in the United States. Another source of hydrocarbon fuels is the digestion of animal wastes. About 50,000 Btu per capita per day could be produced from the annual total of animal waste production. Another category of recycling waste is agricultural crop residues. Two processes are possible—fermentation to make alcohol and anaerobic digestion to produce a combustible mixture of methane and carbon dioxide. About 25,000 Btu per capita per day could be produced. By altering the energy mix, recycling could thus produce 80,000 Btu per capita per day or about two-thirds of the amount of the transportation energy consumed in 1960. (Solid Waste Information Retrieval System)

2801-D3, E3, F6

### RESEARCH AND TECHNOLOGY

Water Resources Newsletter, Vol. 7, No. 5, p. 1-2, October, 1972.

Descriptors: Research and development, Recycling, Feeds, Fuels, Methane, Cattle, Drying, Poultry.
Identifiers: General Electric, Hamilton Standard.

General Electric, in an installation at Casa Grande, Arizona, is using one-cell microbes to digest cattle manure. The resulting biomass, after being dried and powdered, is a tasteless, odorless, nutritious feed for chickens or cattle. Hamilton Standard converts manure into livestock feed using bacteria already present. Enough methane is generated in the process to supply the heat and electricity needed for the operation. (Whetstone, Parker, and Wells-Texas Tech University)

2802-A8,B1,D2,D3,E2,E3,
F1

### GOBAR-GAS PLANTS PROMISES AND PROBLEMS,

Assistant Director, G. G. S. Khadi and Village Industries Commission, 3, Irla Road, Vile Parle (West), Bombay
H. R. Srinivasan
Indian Farming, Vol. 23, No. 11, p. 29, 31, 33, February, 1974.

Descriptors: Fuels, Anaerobic digester, Organic wastes, Fertilizers, Fermentation, Economics, Methane, Carbon dioxide, Nitrogen, Nutrients, Environmental sanitation.
Identifiers: India, Gobar-gas plant, Gas production.

Because of the present shortage of fertilizer, kerosene and petrol in India, it appears that gobar-gas plants can play a major role in preventing the draining away of valuable foreign exchange used for chemical fertilizer and crude oil imports. The gobar-gas plant is an anaerobic digester used for fermenting organic wastes. The digestion is carried out submerged in water. The end products of the anaerobic digestion are (1) Gobar-gas (a mixture of methane, carbon dioxide and minute quantities of $H_2S$ and other gases) and (2) a blackish, odorless, readily drainable, innocuous substance rich in nitrogen and humus. While it is hoped that the gobar-gas can become an accepted source of fuel, there are still problems to be worked out. Since cattle-dung is a very slow fermentor, probably because it is poor in nutrients, some way is needed to collect the cattle urine as well. Also, as day temperatures go down, the gas production falls. The manure presents storage problems. Social adjustment to this new fuel source has posed a problem. It is hoped, however that these problems can be worked out. It is felt that the gobar-gas plant offers a markedly increased income from the farm due to more and better manure, coupled with better living conditions. The gobar-gas manure has given better yields in all crops when compared to farm-yard manure made from the same quantity of cattle dung. (Penrod-East Central)

2803-A2, A4, B2, B4, E2

### FEEDLOT POLLUTION: A SOLVABLE PROBLEM?,

South Dakota Farm & Home Research, Vol. 21, No. 2, p. 30-31, Spring, 1970.

Descriptors: Agricultural runoff, Water pollution, South Dakota, Feedlots, Land management, Precipitation (atmospheric)
Identifiers: Retention ponds.

While he was a civil engineering graduate student at South Dakota State University, Paul Thormodsgard did research on snow and rainfall runoff from certain feedlots. He deducted that good land management could be a more feasible answer to feedlot pollution than expensive waste treatment. He found that a large ditch and a plowed field between the feedlot and a stream diminished the waste runoff. He also suggested that waste introduced into a stream in times of flood may be diluted by the large amounts of water. Thormodsgard pointed out that feedlot runoff is related to type of precipitation and could be held in retention ponds or possibly in a plowed field until conditions are right for its release. (Sanders-East Central)

2804-A6, D2, E3

### REMOVING THE SMELL FROM MANURE

Water and Waste Treatment, Vol. 15, p. 3A, March 1972.

Descriptors: Poultry, Feeds, Drying.
Identifiers: After-burner, Odor removal, Great Britain.

"Removing smells created by processing poultry manure has saved the world's largest operator in this field from closure." A British concern producing agricultural feed by drying the manure quickly at high temperature to preserve its protein value has added "after-burners" which heat the exhaust gases to 600 degrees C before releasing them to a 75-ft stack. "The system has proved 100 per cent effective." (Whetstone, Parker, & Wells-Texas Tech)

2805-D1, D3, E3, F5

### FEEDLOT WASTE USABLE,

Poultry Meat, Vol. 23, p. 16, October, 1972.

Descriptors: Feedlots, Recycling, Feeds, Performance.
Identifiers: Fractionation, Building materials.

A two-step fractionation process for feedlot waste developed by the Agricultural Research Service, USDA obtains a fibrous residue, fifty per cent of the waste, which can be pressed into board or used as a nutrient for fungus that produces a fiber-digesting enzyme. Chicken feed treated with the enzyme has improved digestibility. The fungus itself is almost half protein. (Whetstone, Parker and Wells-Texas Tech)

### 2806-A8, B2, C1, C2, E2

### AN ECOLOGICAL BLUEPRINT FOR TODAY,

Journal of Environmental Health, Vol. 34, No. 1, p. 30-39, July-August, 1971. 6 fig, 3 tab, 3 ref.

Descriptors: Waste disposal, Sampling, Chemical properties, Physical properties.
Identifiers: Land disposal, Spray irrigation, Application rates.

The recycling of human effluent and animal waste by spray irrigation was discussed. Ten acres of cropland and 12 acres of woodland were spray irrigated. Disposal of liquid manure was at the rate of 2 in. per week over a 10-acre tract of cropland which is equivalent to 20 acre-in. or 544,000 gal. Weekly sampling and testing from 32 stations in the spray irrigation area were performed for the presence of turbidity, temperature, dissolved oxygen, phosphates, nitrates, nitrites, pH, ABS, and chlorides. It was found that by taking effluent from agricultural wastes of 200 cows and spray irrigating the crops with this effluent, production was tremendously improved. By utilization of the nutrients and the water, tonnage per acre increased. It was found that animals prefer nutrient-irrigated crops, as the plants are more succulent and contain more phosphorus and other minerals than crops that are just watered. The establishment of a community using spray irrigation for handling sewage waste was also described. Results so far indicate that spray irrigation is an effective system. The waste is applied to croplands and woodlands instead of dumping it into streams and lakes. (Solid Waste Information Retrieval System)

### 2807-B5, C2, D2, D3, E3

### INCREASED PRODUCTION OF BIOGAS FROM COWDUNG BY ADDING OTHER AGRICULTURAL WASTE MATERIALS,

Division of Soil Science and Agricultural Chemistry,
Indian Agricultural Research Institute, New Delhi,
India.
R. D. Laura and M. A. Adnani
Journal of Scientific Food Agriculture, Vol. 22, p. 164-167, April, 1971. 3 fig, 4 tab, 8 ref.

Descriptors: Gases, Methane, Fermentation, Anaerobic conditions, Chemical properties.
Identifiers: Production rates, Agricultural wastes, India.

"It was found that the addition of nitrogenous materials, such as casein, urea or urine, increased the extent of decomposition of cowdung, resulting in higher gas production. The effect appears to be to the maintenance of pH 7 during fermentation. With the addition of urea of CaCO$_3$, materials such as dry leaves and cane sugar have yielded high proportions of methane in the gas mixtures and three additions also increased the rate of gas production by promoting anaerobic conditions in the medium. Addition of cellulose also increased the rate but the gas mixture obtained had a lower methane content." (McQuitty and Barber-University of Alberta)

### 2808-A11, E3

### ABORTION IN CATTLE ASSOCIATED WITH THE FEEDING OF POULTRY LITTER,

Departments of Veterinary Science and Biology,
Pennsylvania State University, University Park
L. C. Griel, Jr., D. C. Kradel, and E. W. Wickersham
The Cornell Veterinarian, Vol. 59, No. 2, p. 226-235, 1969. 3 tab, 7 ref.

Descriptors: Litter, Cattle.
Identifiers: Refeeding, Abortion, Dienestrol-treated feed, Estrogenic activity, Hormonal imbalance.

A study was made to determine the relationship between the feeding of poultry litter obtained from birds that had received dienestrol-treated feed and a series of abortions in a breeding herd of beef cattle. During the period in which the herd was receiving poultry litter, all animals exhibited a great deal of estrual behavior. Upon cessation of the feeding of the litter, this behavior completely disappeared, abortions ceased, and the remainder of the herd subsequently calved normally. While the exact biochemical mechanisms involved in the etiology of the abortions remain unsolved, the evidence indicated that some manner of hormonal imbalance may have been involved. Further work is needed to determine the interactions of all the factors present in this case in causing abortion in cattle. (Penrod-East Central)

### 2809-A1, E3

### FLAVOUR OF BEEF FED ON DRIED POULTRY WASTE,

Agricultural Research Council, Meat Research Institute, Langford, Bristol BS18 7DY
D. N. Rhodes
Journal of Scientific Food Agriculture, Vol. 22, p. 436, August, 1971.

Descriptors: Cattle, Feeds.
Identifiers: Dried poultry wastes, Flavor.

"Indirect comparisons of beef roasts from steers fed on rations containing 25 per cent dried poultry waste and from control animals, taste panels were unable to distinguish between the two meats on the basis of odour or flavour." (McQuitty and Barber-University of Alberta)

### 2810-D2,D3,E1,E2,E3,F1, F4

### LIVESTOCK WASTE: WHY WASTE IT?,

Agricultural Situation, October, 1971, p. 2-4.

Descriptors: Waste disposal, Livestock Economics, Lagoons, Dehydration.
Identifiers: Land disposal, Composting, Refeeding.

Methods of utilization or disposal of manure currently used or under investigation are described briefly. These include land disposal, lagoons, the Pasveer oxidation ditch, composting, dehydration, and animal feeding. (Whetstone, Parker, and Wells-Texas Tech)

### 2811-A3,A5,A6,C1,C2,E2

### THE USE OF ANIMAL WASTES ON FERTILIZER,

Armstrong, D.W.
Journal of Agriculture (South Australia), Vol. 75, p. 178-184, 1972.

Descriptors: Fertilizers, Irrigation, Animal wastes, Nutrients, Feedlots, Chemical properties, Physical properties, Nitrogen, Odor, Agricultural runoff, Groundwater pollution.
Identifiers: Land disposal, Application rates, Australia.

The amounts of manure produced and its composition are discussed. Application rates should not exceed 300 lb of nitrogen per acre to avoid groundwater contamination and other detrimental effects. Application of more than 100 lb per acre is useless. If manure is used for irrigation it should be diluted with water. Odor and runoff can create difficulties. (Whetstone, Parker, and Wells-Texas Tech)

### 2812-A8, B2, C2, E2

### PHOSPHORUS IN PERCOLATES FROM MANURED LYSIMETERS,

Department of Land Resource Science, University of
Guelph, Guelph, Ontario, CANADA
D. G. Bielby, D. A. Tel, and L. R. Webber
Canadian Journal of Soil Science, Vol. 53, No. 3, p. 343-346, August, 1973. 3 tab.

Descriptors: Phosphorus, Percolation, Lysimeters.
Identifiers: Liquid poultry manure.

The objective of this report was to determine if phosphorus from heavy surface applications of liquid poultry manure would be retained by the soil or would occur in the percolates. Over the 3-year study period, the phosphorus added in the treatments was equivalent to 50, 408, and 1,240 and 1,590 kg/ha. During this period, the percolates contained the equivalent of 0.35, 0.65, 0.38, and 0.35 kg of P/ha for the four treatments respectively. The corresponding concentrations of phosphorus in the percolates were 0.029, 0.057, 0.033, and 0.034 mg/l. Although abnormally large amounts of phosphorus were added, the amounts found in the percolates were not correspondingly large. The study confirms the general observation that applied phosphorus tends to remain immobile in the soil. As the water moves through the subsoil, phosphorus attenuation occurs. (Penrod-East Central)

### 2813-A6, A8, E2

### CORN RESPONSE AND SOIL NITROGEN TRANSFORMATIONS FOLLOWING VARIED APPLICATION OF POULTRY MANURE TREATED TO MINIMIZE ODOR,

Research Station, Research Branch, Agriculture
Canada, St. Jean, Quebec J3B 6Z8
K. A. MacMillan, T. W. Scott, and T. W. Bateman
Canadian Journal of Soil Science, Vol. 55, No. 1, p. 29-34, February, 1975. 4 fig, 3 tab, 14 ref.

Descriptors: Crop response, Corn, Poultry, Waste treatment, pH, Nitrification, Ammonification.
Identifiers: Land disposal, Nitrogen transformations.

The objective of this study was to examine the interrelationship between soil nitrogen transformations and corn response, following soil application of manure previously treated to minimize odor. Maximum above-ground yields obtained on Mardin and Honeoye silt loam were 54 and 23 g, respectively, whereas check yields were 9 and 8 g, suggesting that N additions had a greater influence on yield response under acid pH conditions. There were no visible signs of nutrient deficiency in plants from either soil, suggesting that nutrient supply was adequate. As a result of more favorable conditions for nitrification and NH$_3$ volatilization at the higher pH (Honeoye) as opposed to the acid pH (Mardin), there were differences in NH$_4$ plus concentrations between the two soils. The overall increases in NO$_3$—(Honeoye) and NH$_4$ plus concentrations during the course of the experiment indicated that the high N loading rates used were not toxic to the soil microorganisms at each pH value. On consideration of yield response as it related to measured soil N fractions, it was observed that NH positive and NO negative were the major N fractions used by the plants in the acid and neutral soil, respectively. Concentration of $NO_2$- toxic to corn was attributed as causing the substantial yield decreases with the higher rates of OD on the Honeoye soil. The study concluded that the major factor thought responsible for different N concentrations and ultimate corn yield response in each soil was soil reaction. (Penrod-East Central)

### 2814-B1,D1,D2,E3,F1,F5 F6

### CONVERSION OF SWINE MANURE TO PROTEIN,

Department of Soil Science, Oregon State University, Corvallis, Oregon
Larry Boersma
Feedstuffs, Vol. 47, No. 39, p. 20-21, September 22, 1975. 1 fig, 3 tab.

Descriptors: Recycling, Algae, Proteins, Feeds, Economics, Energy, Methane.
Identifiers: Swine.

Oregon State University is experimenting with the use of swine manure as a substrate for growing algae, which may then be used as feed. The economics of such recycling is dependent upon such variables as water temperature, light intensity, depth of culture and retention time. Two harvesting methods were employed: (1) centrifugation and (2) precipitating the material with alum. The algal material obtained by centrifugation was a good source of protein. Alum precipitated algae did not give good results, strongly suggesting that harvesting should be done by centrifugation, air flotation, or some other method which does not add toxic materials. The development of an inexpensive method for harvesting algae has been a major deterrent to the development of commercial algal production. Centrifugation is expensive and energy intensive. It is hoped that methane, which is produced in the initial digestion of the manure, may be used as the energy source. Current experimentation at Oregon State is focused on determining optimum management techniques. (Cannon-East Central)

### 2815 - A6, D3, F1 100

### LIVESTOCK FARMING AND ENVIRONMENTAL PROTECTION,

U. Riemann
Landtechnik, Vol. 28, No. 5, p. 149-153, March, 1973. 9 fig.

Descriptors: Livestock, Waste treatment, Economics, Aerobic conditions, Anaerobic conditions.
Identifiers: Germany.

The livestock industry is confronted more and more with problems of environmental protection linked to costs threatening its competitiveness. The aims of manure treatment regarding odors, pathogens and volume reduction by clarification are considered. Agricultural use of manure appears to be the most economical method. For biological degradation of manure, two techniques are presented. Anaerobic decomposition yields strong smelling decay products and depends mostly on outside temperatures. In aerobic decomposition, few or no offensive smells are created because of the aerobic bacteria. Aerobic degradation is suitable for different types of manure, proceeds quickly and develops its own heat. The aerobic operations of oxidation ditches, oxidation silos, forced-air systems, and their possible improvement are discussed. Composting also involves aerobic biological degradation and is more desirable hygienically. However its marketability is limited by lack of effective cost defrayments. (Text in German) (Solid Waste Information Retrieval System)

### 2816 - B1, E2

### TECHNIQUE OF CONVENTIONAL DUNG DISPOSAL,

E. E. Schilling
Landtechnik, Vol. 28, No. 4, p. 103-106, 1973. 1 fig, 7 tab, 6 ref.

Descriptors: Waste disposal, Transportation, Equipment.
Identifiers: Land spreading.

Dung from conventional farms usually consists for the greatest part of solid substances while dung from mass stock keeping contains mainly liquid matter. The technique of dung disposal is characterized by transportation, dosing and distribution of the dung. Vehicles for the transportation of the dung must be adapted for unpaved roads and usually have one or two axles. Dosing of the dung is effected through a spreading device. According to the velocity with which the dung is led into the spreading device the quantities to be spread amount to from 50 to 400 double quintals per hectare. The situation of the spreading device on the side or back walls of the vehicle determines the distribution of the dung in a small or large range. (Text in German) (Solid Waste Information Retrieval System)

### 2817 - A6, A10, B2, D3, E2, F1, F6

### REMOVAL OF LIQUID DUNG,

U. Riemann and H. Traulsen
Landtechnik, Vol. 27, No. 1/2, p. 12-16, January, 1972. 9 fig, 7 ref.

Descriptors: Liquid wastes, Waste disposal, Lagoons, Aeration, Ventilation.
Identifiers: Oxidation pits.

Various methods to remove liquid manure have been tested. The most economic one is the distribution of the manure on agricultural areas, costs of which will amount to 0.25 to 3.00 DM per cu m of manure. In the USA the disposal of the manure in lagoons is very popular. The dung is led into pools of 2-to-3-m depth where the organic substance is degraded and part of the moisture vaporizes. However, in winter no degradation takes place. Another disadvantage of this method is the development of bad odors and vermin. Some disadvantages of the agricultural utilization of manure can be eliminated by ventilation. The revolving ventilator favors the biological degradation processes. The amount of oxygen added by this type of ventilator is small; thus the developing heat in the manure is not cooled down by too much air. For this reason the surface gyroscope is not adapted for ventilating manure as it adds too much oxygen. The classic method is the oxidation pit where a roll revolves the manure in the pit. Several other methods are still in state of experiment so that exact results as to the advantages and disadvantages cannot be given. (Text in German) (Solid Waste Information Retrieval System)

### 2818 - A4, A5, A6, B2, C3, D1, D2, D3, E2, F1

### LIQUID MANURE AND ENVIRONMENT PROTECTION,

A. Forster
Landtechnik, Vol. 27, No. 8, p. 166-168, April, 1972. 5 fig.

Descriptors: Liquid wastes, Odor, Regulation, Transportation.
Identifiers: Field spreading, Sweden, Switzerland.

A great number of farmers use liquid dung as manure on their fields because transportation costs for this method can be reduced by 30-40 percent. Several European countries provide for special environment protection measures to be applied in this case. Similar to the regulations for the storing of oils and chemical agents, those for storing and utilizing liquid manure will depend on whether the drinking water in the various regions is endangered by the liquid dung. In Sweden and Switzerland, storing liquid dung for 4-9 months is obligatory because after this time a great number of pathogenic microorganisms are destroyed and risk is considerably reduced. Another reason is that during special periods such as holidays or in high pressure areas, spraying liquid dung onto the fields is not allowed in order to prevent the formation of bad odors. Large farms will have to provide for dung deodorization in the future in order to avoid the present disadvantages of dung utilization. Dung deodorization can be effected mechanically, thermally, chemically, or biologically; the latter seems to be the most perfect and economical method. The biological treatment can be effective in a cold, warm or hot way; however, the cold method is the least advantageous since the fertilizing value in its liquid phase is extremely low. Dung treated in this manner can be distributed by means of a spraying device without causing difficulties, however, it will be economical only for farms with an annual dung production of more than 8,000 cu m of liquid dung. Smaller farms should use the new glass-fiber truck-mounted tanks of a volume of 8,000 liters. (Text in German) (Solid Waste Information Retrieval System)

### 2819 - A5, A11, D2, D3, E2, F1

### FIELDS OF USE AND APPLICATION OF MANURE AND MANURE DISPOSAL,

V. G. Blanken
Landtechnik, Vol. [illegible], No. 21, p. 674-676, November, 1970.

Descriptors: Fertilizers, Waste treatment, Waste disposal, Incineration, Drying, Economics, Groundwater
Identifiers: Dumping, Land spreading

Manure can be used for fertilizing agricultural areas, it can be dumped, destroyed by chemicals, biologically decomposed or incinerated. Its use as fertilizer is still the most economic method for disposal of manure, provided that there is agriculture in the area. If not, one of the other methods must be selected. Drying has proved to be economical only in the case of chicken manure. Drying costs for the manure of about 40,000 chickens run at DM 7.00. Conversion into humus is justified only if there is a sufficiently large market for the product. Costs are DM 10.75 for 8,000 chickens. In the absence of a market for manure, it seems to be best to subject it to biological decomposition. There is, however, the problem of disposal of the residual matter. Incineration would be the best method from a sanitary point of view, but it is too expensive. Dumping is too dangerous for the environment. Pollution of the environment by larvae and worm eggs can be avoided, by storing the manure in large containers for long periods of time. For protection of the groundwater small amounts of manure ought to be spread over the fields at one time, and used on flat acres only. (Text in German).(Solid Waste Information Retrieval System)

### 2820 - A1, A5. A6,A8, A11, A12, C3, D2, D3, E2, F1, F2, F4

### UTILIZATION AND DISPOSAL OF LIQUID MANURE AT SMALL AVAILABLE SPACE,

V. H. Traulsen
Landtechnik, Vol. 25, No. 21, p. 665-668, November, 1970. 7 fig, 7 ref.

Descriptors: Liquid wastes, Waste treatment, Waste disposal, Economics, Odor, Groundwater pollution, Pathogens, Incineration, Drying
Identifiers: Land spreading, Spraying, Composting, Oxidation tanks, Germany

Of the manure disposal and utilization methods, spraying of liquid manure over crops is the least expensive one. Generally 40-60 cbm liquid manure can be applied per hectare and year. Some plants such as corn are able to consume up to 100 cbm per hectare and year, asparagus as much as 200 cbm. Pathogenic germs are not killed by this method. In the German Democratic Republic, it is required to store manure for 21 days before it is applied to the fields. Studies have shown that salmonellas survive almost one year in liquid manure. Other drawbacks of this method are that the manure cannot be applied to the fields at each season since it causes annoying odors and pollutes groundwater. Spreading over areas which are then withdrawn from agricultural use for one or more years bears the same disadvantages. Composting by mixing with lime, peat, and styropor has not been done yet with any manure other than chicken manure. Decomposing in lagoons does not kill all pathogenic germs either. Anaerobic decomposition is too expensive. Incineration is the most hygienic method but it involves high investment and operating costs. Composting and drying and oxidation tanks are the most economical methods available at the moment. (Text in German) (Solid Waste Information Retrieval System)

### 2821 - B3, B4

### MANURE REMOVAL AND STORAGE OF SOLID MANURE,

V. H. Schulz, L. Krinner, and K. Wissmuller
Landtechnik, Vol. 25, No. 21, p. 657-665, November, 1970. 11 fig, 3 tab.

Descriptors: Solid wastes, Waste storage, Equipment.
Idenfifiers: Mechanical scraper.

Removal of manure in a solid state is frequently preferred over the liquid manure removal system since straw can be used here in the sheds for insulation against the cold concrete floor and reduction of odor. For solid manure removal, the cow sheds are usually divided into small boxes with a feeding table for the animals outside them. In the rear the manure is removed either by various types of scrapers, of which the two-winged flat arrowhead scraper is gaining increasing importance, or by tractors. The latter are quite versatile and can be used for other purposes, too. Front loaders require, however, at least 8 m of free space in the front of the shed, a door opening of 1.6 to 2.0 m wide and 2.5 to 3.0 m high and a manure track which is at least 1.7 to 1.9 m broad. More recently a number of smaller more mobile manure removal tractors have been introduced. One is a mini bucket-wheel-loader similar to the one used by construction workers for soil removal. It is driven by two starter batteries each with 12 volts and two dc motors. The electrically-hydraulically operated front loader carries a moveable shovel which can be equipped with prongs. Another such unit driven by a 12 HP single cylinder diesel engine consists of a three-wheeled chassis. It carries various shovels and rakes in addition to the loader. (Text in German) (Solid Waste Information Retrieval System)

### 2822 - B2, B3, B4

### MANURE REMOVAL AND STORAGE OF LIQUID MANURE,

V. K. Grimm
Landtechnik, Vol. 25, No. 21, p. 645-649, November, 1970.

Descriptors: Waste storage, Equipment.
Identifiers: Mechanical scrapers.

If an automatic manure drain-off system is used in sheds, no fodder or straw can be placed in the animal resting place since it tends to clog the drainage pipes. If a straw-bed is to be provided for the animals it is advisable to use mechanical scrapers for removal of the manure. The arrowhead scraper is increasingly used for this purpose; it consists of two wings which are movably joined together in the form of an arrowhead. They are drawn by a chain which runs in a central guide rail. For storage of manure multi-chamber containers, dug-in containers open on top, and containers partly submerged in the ground are available. They can be made of wood, concrete, steel or plastic material. (Text in German) (Solid Waste Information Retrieval System)

### 2823 - A1, A5, A6, A11, A12, D2, E2

### THE PROBLEM OF MANURE UTILIZATION IN LARGE ANIMAL HUSBANDRIES,

V. G. Blanken
Landtechnik, Vol. 25, No. 21, p. 642-644, November, 1970. 2 fig, 4 tab.

Descriptors: Livestock, Poultry, Incineration, Waste disposal, Crop response, Groundwater pollution, Odor
Identifiers: Land spreading, Germany

In animal husbandries of the Federal Republic of Germany, 135 million tons of manure accumulate per year. Considering that the agriculturally useable area spans 13.9 million hectares, this amount of manure does not seem so high. Uniform distribution of the manure over the entire acreage would bring 10 tons of manure to one hectare. Unfortunately, however, animal husbandries tend to concentrate in one area so that distribution of manure over all agriculturally useable areas would mean transportation over long distances involving additional cost. Other ways and means for disposal of manure must be found. Incineration seems the most aesthetic solution since it yields a sterile end product. It is also the most hygienic solution since it renders the end product free of any pathogenic germs, worm eggs or larvae. One chicken produces about 0.175 kg manure per day, a cow produces about 40 or 50 liters of liquid manure (including urine). Distribution of all manure onto the nearby fields is too much of a burden to the soil and as a consequence the crop yield drops. It is also an additional burden to the digesters but not as much to the groundwater. The odor annoyance must be considered too. All of this, plus the fact that artificial fertilizers are preferred over manure, leads to the conclusion that some other method of disposal must be found in addition to incineration which is simpler and less expensive. (Text in German) (Solid Waste Information Retrieval System)

### 2824 - A2, A6, A7, A8 B2, B3, C1, C2, C3, D1, D2, D3, E2, E3, E4, F1, F2, F3, F4, F5

### LIVESTOCK WASTE MANAGEMENT WITH POLLUTION CONTROL,

Oregon State University, Corvallis
J. R. Miner and R. J. Smith, eds.
North Central Regional Research Publication 222, Midwest Plan Service, June, 1975, 89 p. 45 fig, 58 tab, 277 ref.

Descriptors: Farm wastes, Feedlots, Biological properties, Chemical properties, Physical properties, Separation techniques, Waste treatment, Byproducts, Transportation, Odor, Dusts, Agricultural runoff, Aerobic treatment, Anaerobic treatment, Recycling.
Identifiers: Waste management, Land application, Refeeding, North Central U.S., Housing.

The aspects of livestock waste management described in this report reflect the variations encountered across the 13 states of the North Central Region. The main objective of this report is to present information on waste management that will free a livestock producer from unnecessary labor, yet, at the same time, will allow him to operate within the confines of current environmental legislation. The NC-93 committee recognizes that such an objective alone is inadequate; hence, there are large sections of the report devoted to by-product recovery. The report summarizes the necessary features of any livestock-waste-management system and presents basic information on manure production and content. The effect of housing on livestock-waste management is discussed in terms of roofed facilities and unroofed facilities. Air pollution by gases and dust is regarded of such importance that one whole section is devoted to this topic. Conventional biological waste stabilization is discussed in two sections on aerobic and anaerobic treatment. The section on utilization attempts to analyze manure-processing technology for harvesting useful by-products. Some of the topics discussed include land application with crop production, hydroponics, composting, production of livestock feed supplements, and pyrolysis. The report culminates with two sections on information retrieval and technical terms encountered in livestock waste management. (Miner & Smith-Oregon State University, Merryman, ed.) (Publication available for 2.00 from Midwest Plan Service, Iowa State University, Ames 50010)

### 2825 - A4, C2, C3, F2

### DEVELOPMENT DOCUMENT FOR EFFLUENT LIMITATIONS GUIDELINES AND NEW SOURCE PERFORMANCE STANDARDS: FEEDLOTS POINT SOURCE CATEGORY,

Effluent Guidelines Division
Office of Air and Water Programs
U.S. Environmental Protection Agency
Washington, D. C. 20460
R. E. Train, R. L. Sansom, A. Cywin, J. D. Denit

Environmental Protection Agency Report Number EPA-440-1-74-004-a, January, 1974, 319 p. 68 fig, 41 tab, 257 ref.

Descriptors: Effluent, Waste water disposal, Regulation, Feedlots, Livestock, Poultry
Identifiers: Guidelines, Environmental Protection Agency, Federal Water Pollution Control Act Amendments of 1972

This document presents the findings of an extensive study of the feedlot industry for the purpose of developing proposed regulation; providing guidelines for effluent limitations and Federal standards of performance for the industry to implement sections 304 and 306 of the Federal Water Pollution Control Act mal types were considered in this study: beef cattle, dairy cattle, swine, chickens, turkeys, sheep, ducks and horses. Guidelines are set forth for effluent reduction attainable through the application of the "Best Practicable Control Technology Currently Available," the "Best Available Technology Economically Achievable" and for New Source Performance Standards. The proposed recommendations require no discharge of process wastewaters to navigable water bodies by July 1, 1977 except for precipitation event(s) in excess of the 10 year, 24 hour storm for the location of the point source for all animal types except ducks. Duck growing operations will be required to meet a limitation on BOD and bacterial pollutants using biological treatment (e.g. 2.0 pounds of BOD per 1000 ducks). By 1983, the no discharge limitation will apply to all animal types except for precipitation event(s) in excess of the 25 year, 24 hour rainfall. The latter limitation also applies to all new sources. Supportive data and rationale for development of the proposed guidelines for effluent limitations are presented. (T-rain, et.al. EPA)

### 2826 - A4, F2

### CONTROL OF POLLUTION FROM ANIMAL FEEDLOTS,

U. S. Committee on Government Operations
Hearings before a Subcommittee of the Committee on Government Operations, House of Representatives, Ninety-third Congress, First Session, November 29 and 30, 1973.

Descriptors: Feedlots, Water pollution, Regulation.
Identifiers: Pollution control, Manure, Subcommittee on Conservation and Natural Resources.

The Subcommittee on Conservation and Natural Resources held hearings on November 29 and 30, 1973 for the inauguration of an in depth study of manure. Attempts were made in these hearings to ascertain whether Federal pollution control laws are administered efficiently, economically, and so implemented as to control pollution from point sources such as animal feedlots. Testimonies were given from representatives of EPA and other Federal agencies and interested parties to determine the agencies' role in controlling pollution from animal feedlots. This 1268 page publication may be obtained from the Committee on Government Operations, 2157 Rayburn Bldg., Washington, DC 20515. (Cameron-East Central)

## 2827 - A8, B2, C1, C2, D3, E2,

### CHARACTERISTICS AND SOIL TREATMENT OF BIOLOGICALLY TREATED SWINE WASTES, VOL. I, CH. 1 through 3,

Water Resources Institute, Kansas University, Lawrence
C. E. Burkhead and M. Trnovsky
Kansas Water Resources Research Institute Contribution No. 132, February, 1974, 118 p. 6 fig, 23 tab.

Descriptors: Soil treatment, Oxidation Lagoons, Biological treatment, Farm wastes, Waste water treatment, Kansas, Hydraulic conductivity, Feasibility studies, Waste identification, Waste disposal, Water reuse, Soil types, Infiltration, Path of pollutants.
Identifiers: Swine wastewater, Land disposal, Waste characterization, Holding ponds, Percolate characteristics, Soil columns, Loading and resting cycles.

Feasibility of treatment and disposal by land application of a holding pond supernatant receiving effluents from oxidation ditches treating swine waste generated in a confined hog growing operation was investigated. The performance of the three oxidation ditches and the holding pond was evaluated. The evaluation was based on statistical analyses of physical and chemical characteristics of the oxidation ditch effluents and the holding pond supernatant. The wastewater was analyzed from data collected from ten random samples for each of the following sampling locations: effluents from the oxidation ditches, the holding pond supernatant, and well water. In addition, data on water consumption, number of hogs in the buildings, and rainfall data were collected. Suitability of five typical Kansas soils for treatment and disposal of the holding pond supernatant was investigated in fifteen indoor soil columns. The columns contained disturbed soil samples representing the following textural classes: sand, sandy loam, silt loam and clay. The wastewater was applied to the column in alternate loading-resting cycles. Infiltration rates and quality changes of the percolate were monitored. Changes in the soil's chemical characteristics as brought about by the application of the supernatant were determined on ten soil columns' increments upon termination of testing. (Burkhead-Kansas Water Resources Research Institute)

## 2828 - A8, B2, B5, C1, C2, D3, E2

### CHARACTERISTICS AND SOIL TREATMENT OF BIOLOGICALLY TREATED SWINE WASTE, VOL. II, CH. 4 through 7,

Water Resources Institute
Kansas University
Lawrence
C. E. Burkhead and M. Trnovsky
Kansas Water Resources Research Institute Contribution No. 132, February, 1974, 202 p. 76 fig, 23 tab, 183 ref.

Descriptors: Soil treatment, Oxidation lagoons, Biological treatment, Farm wastes, Waste water treatment, Kansas, Hydraulic conductivity, Feasibility studies, Waste Identification, Waste disposal, Water reuse, Soil types, Infiltration, Path of pollutants
Identifiers: Swine wastewater, Land disposal, Waste characterization, Holding ponds, Percolate characteristics, Soil columns.

Variation among the physical and chemical characteristics of the oxidation ditch effluents and the holding pond supernatant provided evidence of unsatisfactory in-building management, causing overloading of the oxidation ditches and accumulation of biodegradable pollutants in the oxidation ditch mixed liquor as well as in the holding pond supernatant. Application of the supernatant to the selected soils demonstrated that the soil's retention capacity for the supernatant constituents is definitely limited. The soil's retention capacity increased with the clay content of the soil and decreased with the wastewater volume applied. In the course of testing, the quantity of the supernatant soluble organics, salts, alkalinity, and cations in the columns' effluents increased appreciably with an increase in quantity applied. Basic relationships controlling the transformation of the major wastewater constituents are described. (Burkhead-Kansas Water Resources Research Institute).

## 2829 - A11, B2, B4, C2, C3, D3, F6

### WATER MANAGEMENT IN LIVESTOCK WASTE HANDLING SYSTEMS,

Clemson University
Clemson, South Carolina 29631
C. L. Barth and J. H. Bond
Report No. 51, South Carolina Water Resources Research Institute, January, 1975, 87 p. 35 fig, 11 tab, 23 ref.

Descriptors: Wastewater treatment, Water management (applied), Farm wastes, Farm lagoons, Aerobic conditions, Hogs, Salmonella, Mathematical models, Water reuse, Liquid wastes, Water conservation, Waste storage, Waste Treatment.

The potential for minimizing the use of water in several animal waste treatment and storage procedures were evaluated. Laboratory units simulated the operation of aerobic lagoons, anaerobic lagoons, and storage for diluted swine feeding floor waste under conditions of controlled temperature, lighting, loading rate and detention time. Reduction of volatile solids (VS) content under conditions similar to those of aerobic lagoons was limited due to algae production. Anaerobic lagoon simulators achieved volatile solids reduction rates of 75.8 percent at 24 C and 200 days detention time and as little as 22.1 percent at 10 C and 100 days detention time. Degradation of VS was generally high in the loading rate range of 50 to 400 g vs/day-$m^3$ and sludge storage efficiency was also high in that range. Liquefaction was a significant factor in the storage simulators with reductions of total solids by as much as 69 percent. Survival of the swine pathogens Salmonella cholerae-suis and Salmonella typhimurium in laboratory simulators of swine manure lagoons was determined and compared with the survival of the indicator organisms Escherichia coli and fecal coliforms. The heaviest populations of the pathogens died off in 33 days. A cause for Salmonella die-off was proposed. A mathematical model was developed to describe the operation of the anaerobic animal waste lagoon and compared with relevant data which characterized the lagoon simulators. The symbiotic relationship of the acid formers (facultative heterotrophs) and methane formers (obligate anaerobes) was emphasized along with the possible inhibition of both cultures by high concentrations of volatile organic acids. (Barth-Clemson University)

## 2830 - A11, C2, E3

### COMPOSITION AND DIGESTIBILITY OF CATTLE FECAL WASTE,

Virginia Polytechnic Institute and State University
Blacksburg
D. M. Lucas, J. P. Fontenot, and K.E. Webb Jr.
Journal of Animal Science, Vol. 41, No. 5, p. 1480-1486, November, 1975. 1 fig, 6 tab, 29 ref.

Descriptors: Feeds, Cattle, Sampling, Chemical properties
Identifiers: Digestibility, Dried feces, In vitro studies

Recently three tests were made with six steers to study the digestibility of fecal waste. In Test 1, steers were fed 50 percent roughage containing high protein and TDN levels. Fecal samples were taken and the remaining feces were dried for 24 hours in a forced drafted oven at 120 degrees C and then ground. The chemical composition of the feces was 13.2 percent crude protein, 31.4 percent crude fiber, 2.8 percent ether extract, 5.4 percent ash, 47.2 percent NFE, 70.9 percent cell walls and 44.8 percent ADF, dry basis. In Tests 2 and 3, the animals were fed 80 percent basal ration and 20 percent dried feces. Results from Test 1 showed 68.2 percent digestiblity for dry matter, compared with 57.4 percent for the ration containing 20 percent dried feces. The digestibility of crude protein was 69.4 percent in Test 1 and 61.3 percent for the 20 percent dried feces ration. The in vitro method of study used in this experiment seems to be a useful means of determining relative digestibilities of waste materials. (Cannon-East Central)

## 2831 - B2, C2, D3

### EPA'S NEW FEEDLOT DISPOSAL PLAN,

Calf News, Vol. 9, p. 49, 62, August, 1971.

Descriptors: Feedlots, Agricultural runoff, Waste treatment, Phosphates, Nitrogen
Identifiers: Biological filter, Retention ponds

The Robert S. Kerr Water Research Center in Ada, Oklahoma, is attempting to perfect a process wherein a colony of micro-organisms will purify the effluent from a 12,000-head feedlot on 8 to 10 acres of grassy slope. Using a 2-to-6 percent slope, with terraces, on soil too heavy to irrigate, the process removes better than 80 percent of the phosphate and about 95 percent of the nitrogen. A two-pond system is used with effluent being pumped from the second pond after 2 or 3 days retention. Start-up requires about six weeks to allow the colony to establish itself. The water supply must be nearly continuous. (Whetstone, Parker, & Wells-Texas Tech)

## 2832 - A7, A11

### THE PIG'S AIR ENVIRONMENT,

Associate Professor of Environmental Physiology,
Department of Animal Science
Illinois University
Urbana-Champaign

S. E. Curtis
Reports of the Sixteenth Annual Swine Day, Special Report 426, Agricultural Experiment Station, Oregon State University, Corvallis, December, 1974, p. 7-9.

Descriptors: Air pollution, Health, Performance, Odor, Gases, Dusts, Microorganisms, Confinement pens
Identifiers: Swine

There is a trend in the pork industry toward more-or-less enclosed confinement and year-round production. The air in enclosed swine houses is polluted with dust, microbes, gases, and odorous compounds that arise from feed, wastes, and the pigs themselves. Eight questions concerning the pig's air environment are posed and answered. The questions and answers (based on experiments described in the paper) are: (1) How much dust is there in swine-house air?—an average of 1,326 µg per cubic meter, (2) What is the bacterial level in swine house air?—an average of 102,920 bacterial-colony-forming particles per cubic meter, (3) Do aerial dust and bacterial levels in swine houses change with time?—Air pollution in swine houses tends to be higher in winter than in summer, probably because ventilation rate is usually reduced in winter, (4) Are dust and bacterial levels in swine-house air related?—yes, (5) What kinds of bacteria occur in swine house air?—The ratio of the bacterial-colony-forming particle count on the special medium for staphylococci to that on the general medium was 0.36; on the special medium for fecal streptococci compared to the general medium was 0.13; and on the special medium for coliforms compared to the general medium was 0.01, (6) What sizes are aerial bacterial-colony-forming particles in swine-house air?—21 percent of the staphylococcal and streptococcal-colony-forming particles, respectively, and 9 percent of the coliform-colony-forming particles, were less than 4.7 µm in aerodynamic diameter. (7) Do atmospheric ammonia, hydrogen sulfide or dust reduce the rate of gain in healthy pigs?—No, not in the amount commonly found. (8)Does atmospheric ammonia reduce the ability of the pig's lungs to resist bacterial infection?—Yes, it appears to. (Merryman—East Central)

### 2833 - B2, B3, D1, D3, E3, E4

### NEW CONCERNS IN SWINE WASTE MANAGEMENT,

Associate Professor, Department of Agricultural Engineering, Oregon State University, Corvallis
J. R. Miner and L. Boersma
Reports of the Sixteenth Annual Swine Day, Special Report 426, Agricultural Experiment Station, Oregon State University, Corvallis, December 1974, p. 16-21. 2 fig.

Descriptors: Recycling, Design, Anaerobic digestion, Algae, Separation techniques, Feeds.
Identifiers: Swine, By product recovery

A waste management system is being tested in Oregon State University in which swine manure from a confinement operation and waste heat from a thermal electric generating plant may be combined for growing algae. A flushing gutter in the swine confinement building carries the slurry to a sump, from which the slurry is pumped to a liquid-solid separator. The liquid-solid separator is mounted over an anaerobic digester so that the solids may be introduced into the digester without further handling difficulties. The digester contents are agitated and heated to maintain a 95 degrees F temperature. In a full-scale operating system, the heating would be done with waste heat from power plant cooling water. Effluent from the anaerobic digester is combined with discharge from the liquid-solid separator and the 2 liquids are used as input feed to a series of algae-growing basins. Effluent from the algae-growing basins is discharged into a storage tank from which accumulated liquid will be pumped to a centrifuge which will separate the water from the algal cells so that the water may be returned to the flush tanks for re-use in manure transport. The harvested algae is to be evaluated as a potential swine feed ingredient by chemical analysis and eventual feeding to experimental animals. The gas produced by the anaerobic digester, which in a full-scale operating system might be used as fuel, is discharged into a soil absorption field designed to deodorize the gas. Experimental results are not yet available. (Merryman-East Central)

### 2834 - A10, B1, D3

### MANURE MANAGEMENT TO CONTROL FLIES,

J. Falter
Poultry Digest, Vol. 34, No. 403, p. 375, September, 1975.

Descriptors: Poultry.
Identifiers: Fly control, Coning, Waste management.

While a poultry producer may already have a firmly established fly control system, there are still things that might be done to improve that system. In a dry-system with infrequent clean-out, it is recommended that under cage cleaning be done early enough to allow a pad of manure and some coning to start before fly season arrives. Proper grading, adequate roof overhang and proper construction and maintenance of watering devices will eliminate much moisture accumulation. Also, eggs should not be thrown into the manure. Weeds should be removed from around the poultry houses to improve air circulation and sun penetration. Built-up manure systems have the added advantage of maximizing development of biological control agents like predaceous and parasitic insects and mites which destroy eggs, larvae and adult flies. In a dry-system with frequent cleanout, weekly or twice weekly removal of droppings followed by proper disposal successfully breaks the fly life cycle, but clean-out must be thorough. Liquid systems are usually excellent for fly control, but odor may become a problem. (Merryman-East Central)

### 2835 - C1, C2, E3, F2

### COLORADO ADOPTS PROCESSED WASTE FEEDING RULES,

Feedstuffs, Vol. 47, No. 49, p. 5, 38, December 1, 1975.

Descriptors: Colorado, Regulation, Feeds, Chemical properties, Physical properties
Identifiers: Refeeding

Rules adopted by the Colorado Department of Agriculture concerning the use of processed animal waste products became effective on October 15, 1975. These regulations allow state registration and intrastate sale of processed animal waste products which meet the following specified requirements: (1) No processed animal waste shall contain such extraneous materials as metal, glass, wire, nails, etc. (2) Dried Poultry Waste shall not contain (a) less than 20 percent crude protein, (b) more than 15 percent crude fiber, (c) more than 30 percent ash, (d) more than 1 percent feathers, (e) more than 12 percent moisture, or (f) more than 20 precent litter. (3) Dried Poultry Litter shall not contain (a) less than 18 percent crude protein, (b) more than 40 percent crude fiber, (c) more than 30 percent ash, (d) more than 5 percent feathers, or (e) more than 12 percent moisture. (4) Dried Ruminant Waste shall not contain (a) less than 12 percent crude protein, (b) more than 30 percent crude fiber, (c) more than 30 percent ash, or (d) more than 40 percent straw, wood, wood shavings, litter, dirt, sand, rocks or other similar extraneous materials, or (e) more than 12 percent moisture. (5) Undried Processed Animal Waste Products shall not contain more than 40 percent straw, wood, wood shavings, litter, dirt, sand, rocks or other extraneous materials. (6) Any product labeled as or containing dried animal waste products shall be 12 percent moisture or less to aid in maintaining microbiological quality. (Merryman-East Central)

### 2836-C2, D2, D3, F6

### ANAEROBIC DIGESTION OF BEEF MANURE AND CORN STOVER,

Agricultural Engineering Department, Iowa State University, Ames
M. E. Hein, R. J. Smith, and R. L. Vetter
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4542, 18 p. 6 fig, 2 tab, 11 ref.

Descriptors: Anaerobic digestion, Equipment, Energy, Chemical properties, Chemical oxygen demand.
Identifiers: Gas production, Cattle manure, Iowa State University, Loading rate.

An experimental digester of about 100 gal (379 dm$^3$) was established at Iowa State University in order to: (1) examine gas recirculation mixing with regard to lowest energy input that would not lead to biological failure, (2) examine the operating variables of loading rate and detention time, and (3) monitor changes in chemical composition of manure as it passes through the digester and to correlate the COD with gas production. Operating experiences are reviewed. It was determined that: (1) Satisfactory mixing of a 100 gal (379 dm$^3$) digester requires a gas-recirculation rate of at least 3 cfm/13$^3$ gal (3.7 x 10$^{-4}$ m$^3$/sec m$^3$) and more than 5 cfm/10$^3$ gal (6.2 x 10$^{-4}$ m$^3$/sec m$^3$) would be preferable,(2) Inadequate mixing results in temperature gradients that cause lower gas production, (3) Adequate mixing will control scum-layer formation, (4) Approximately 45 percent reduction inCOD can be expected at a detention time of 9 days, (5) Specific production corrected to 20 degrees C was about 13.7 ft$^3$/lb COD destroyed (0.86 m$^3$/kg COD), (6) During warm weather, mixing energy is about 20 percent of the total energy input required. The remaining 80 percent is required for heating, and (7) At the loading rate and detention times used (0.45 lb vs/day ft$^3$, 7.2 kg vs/day m$^3$; detention time 9 days), inhibition from high ammonia concentrations was not observed. (Merryman-East Central)

### 2837 - A2, B5, E2

### POLLUTION ABATEMENT FROM CATTLE FEEDLOTS IN NORTHEASTERN COLORADO AND NEBRASKA,

Agricultural Research Service, United States Department of Agriculture, P. O. Box E, Fort Collins, Colorado
L. K. Porter, F. G. Viets, Jr., T. M. McCalla, L. F. Elliott, F. A. Norstadt, et. al.
Environmental Protection Agency Report, EPA-660/2-75-015, June, 1975, 120 p. 27 fig. 34 tab, 112 ref.

Descriptors: Pollution abatement, Feedlots, Colorado, Nebraska, Cattle, Livestock, Waste disposal.
Identifiers: Rainfall runoff, Land application, Water pollution potentials, Waste characteristics.

Climatic factors, feedlot runoff, and organic material in the runoff were evaluated in experimental and commercial feedlots. The effects of slope, stocking rates, terraces, basins, and holding ponds were evaluated to obtain the best controls for containing runoff. In eastern Nebraska, 70 cm annual precipitation produces 23 cm of runoff; whereas, in northeastern Colorado, 37 cm annual precipitation gives only 5.5 cm of runoff. Large applications of runoff liquid, up to 91 cm on grass-Ladino and 76 cm on corn, in Nebraska did not decrease yields; however, in northeastern Colorado, the concentrated high-salt runoff required dilution before direct application to crops. The organic manure-soil interface severely restricts the movement of water, nitrates, organic substances, and air into the soil beneath feedlots. The amounts of $NO_3$-N in soil cores taken from Nebraska feedlots and croplands ranked as follows: abandoned feedlots greater than feedlot cropland greater than upland feedlots greater than river valley feedlots greater than manure mounds greater than alfalfa greater than grassland. Feedlots contribute $NH_3$, amines, carbonyl sulfide, $H_2S$, and other unidentified substances to the atmosphere. Ammonia and amine can be scavenged from the air by green plants and water bodies. Anaerobic conditions in feedlots are conducive to the production of carbonyl sulfide, $H_2S$, and amines. Management practices, such as good drainage, that enhance aeration will decrease the evolution of these compounds. (Porter, et. al.-USDA)

### 2838 - A9, A10, B5

### METHOPRENE AS A FEED ADDITIVE FOR CONTROL OF THE HOUSE FLY BREEDING IN CHICKEN MANURE,

Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg
G. C. Breeden, E. C. Turner, Jr. and W. L. Beane
Journal of Economic Entomology, Vol. 68, No. 4, p. 451-452, 1975.

Descriptors: Feeds, Additives, Poultry.
Identifiers: Methoprene, Fly control.

An experiment was conducted utilizing methoprene in 2 forms for control of house fly breeding in chicken manure. An 86.9 percent technical formulation (acetone solution sprayed on feed) and an incapsulated 7 percent dry premix formulation (blended with feed by mixer) were used as treatment additives. White Rock hens were fed and watered in groups of five. Three replicates of each group were used for each treatment rate. Hens receiving the technical formulation received treated feed at rates of 0, 25, 50, and 100 ppm for 7 days and untreated feed for the following 7 days. Hens receiving the dry pre-mix formulation received the treated feed at rates of 0, 25, 5, and 10 ppm for 10 days and untreated feed for the following 4 days. Bioassay data from the technical formulation treatments indicate that good consistent inhibition of housefly emergence began on the third day for the 50 ppm rate and on the first day for the 100 ppm rate. Posttreatment data indicate that the time required for all the unmetabolized methoprene to leave the chicken increased with treatment rate. Bioassay data from the encapsulated dry premix formulation indicate that good consistent inhibition of house fly emergence began on the eighth day for the 5 ppm rate and the first day for the 10 ppm rate. Posttreatment data indicate no difference between treatment rates in the amount of time required for all the unmetabolized methoprene to leave the chicken. While methoprene shows promise as a feed additive for the control of house flies breeding in chicken manure, the encapsulated formulation was definitely superior to the technical formulation. Ten times less encapsulated formulation achieved the same level of control as the technical formulation. (Cocon-East Central)

## 2839 - A2, A4, C1, C2
### POLLUTION POTENTIAL OF RUNOFF FROM LIVESTOCK FEEDING OPERATIONS,

Instructor in Agricultural Engineering, Water Resources Institute, South Dakota State University, Brookings
J. M. Madden and J. N. Dornbush
Presented at 1971 Annual Meeting, American Society of Agricultural Engineers. Washington State University, Pullman, June 27-30, 1971, Paper No. 71-212, 15 p. 5 tab. 3 ref.

Descriptors: Agricultural runoff, Pollution, South Dakota, Feedlots, Livestock, Precipitation (atmospheric).
Identifiers: Statistical analysis.

A 2-year study was conducted to determine the quantity and quality of runoff from production feedlots in eastern South Dakota. A statistical analysis was used in evaluating the relationship between runoff volume, precipitation amounts, and animal concentration and the pollutional constituents associated with runoff. The following conclusions were drawn: (1) Estimation equations using feedlot characteristics and design runoff volumes can be applied to determine the total and suspended solids, plant nutrients, and oxygen demanding material in feedlot runoff. (2) Conventional methods of determining runoff from rainfall may not give accurate estimates of runoff from livestock feedlots. (3) Although the annual losses of animal waste from feedlots by runoff represent a small percentage of the total waste produced, the quantities are sufficient that control measures must be provided on feedlots whose runoff reaches lakes and streams. Further study is needed. (Merryman-East Central)

## 2840 - A11, D3, E3
### RECYCLED MODIFIED SWINE WASTES.

Feedstuffs Vol. 27, No. 52, p. 26, December 22, 1975.

Descriptors: Diets, Fermentation, Sterilization
Identifiers: Refeeding, Swine

A model system was built for the collection of raw swine wastes for aerobic fermentation, concentration, sterilization and refeeding as a supplement to growing-finishing pigs. The fermented liquid product was substituted for drinking water and used as a supplement to meal diets deficient in mineral, protein, and vitamins. Fifty pigs were used in this 6-week study. Pigs offered the waste as a supplement to a low mineral diet performed much the same as pigs on the low mineral diet, but not as well as pigs fed a complete diet. When a low mineral, low protein, low B-complex vitamin diet was supplemented with "waste", there was further reduction in feed intake and gains. The conversion of non-protein nitrogen to protein nitrogen was not an efficient process. Further study is needed. (Merryman-East Central)

## 2841 - D2, E3, E4, F6
### PLASTIC FROM MANURE,

Hoard's Dairyman, Vol. 120, No. 20, p. 1195, October 25, 1975.

Descriptors: Recycling, Byproducts, Plastics, Methane, Fertilizer.
Identifiers: Ethylene, Anhydrous ammonia, Ethane.

Texas Tech researchers have discovered that beef cattle manure can yield significant amounts of ethylene—"the backbone of the plastics industry." Research was conducted with the intention of showing that feedlot waste could be converted into synthetic gas used for the production of anhydrous ammonia fertilizer. But it was discovered that methane, ethane, and ethylene were produced as well. Assuming a realistic value of 10 cents per pound for ethylene, a conservative estimate of the value of the ethylene production from manure produced from a 100,000-head feedlot in the Texas high plains is around $1.8 million per year. Research is continuing with the objective of improving the process in order to increase the ethylene production. (Merryman-East Central)

## 2842 - A8, E2, F1
### BORROWING HUMUS FROM THE "BANK OF ORGANIC WASTES"

Compost Science editor
J. Goldstein
Compost Science, Vol. 16, No. 5, p. 2-3, Autumn, 1975

Descriptors: Organic wastes, Fertilizers, Costs, Energy, Microorganisms.
Identifiers: Composting.

Several studies are cited which support the premise that use of organic matter as fertilizer is equal to or superior to the use of chemical fertilizers. According to a 1975 chemical fertilizer vs. organic fertilizer comparison study sponsored by the National Science Foundation, organic farmers can produce about as much food per acre with about one-third the energy. While conventional farmers spent an average of $17.33 per acre on fertilizers, organic farmers spent only $6.17. T. M. McCalla, USDA microbiologist at the University of Nebraska, is credited with projecting the importance of the interrelationship between organic wastes applied to the soil, and the microorganisms which decompose them. Dr. McCalla emphasizes that "...it is absolutely essential that we have this microbial transformation in order for man to survive." The editors of Compost Science feel that studies concerning the composting of organic wastes are not being pushed enough. They state that "while it takes a long time to give more than lip service to the value of organic matter in soil and to using organic wastes from cities and farms efficiently in crop production, there's little doubt that we are moving in that direction." (Merryman-East Central)

## 2843 - A2, B1, F1
### ROUNDING UP RUNOFF: REFLECTIONS IN WASTE HANDLING SYSTEMS,

Staff editor
M. Lane
Feedlot Management, Vol. 17, No. 12, p. 13-15, December, 1975. 3 fig.

Descriptors: Feedlots, Planning, Design, Agricultural runoff, Cost sharing
Identifiers: Soil Conservation Service, Runoff control

In order to participate in Soil Conservation Service programs, a feedlot owner must sign an agreement as a cooperator in the local soil conservation district or must be receiving Agricultural Stabilization and Conservation Service cost-sharing funds. Once one of these qualifications is met, expert planning assistance is at the feedlot owner's disposal through consultation with the SCS. SCS usually assists in small projects such as construction of farm ponds or terracing to prevent erosion, but it may also be called upon to assist in planning a whole feedlot design, giving guidance concerning runoff control measures. The design of all runoff control systems contains 3 basic elements—a lagoon; a diversion around the feedlot to direct water falling inside the lot into the lagoon; and a clean water diversion, which keeps water running into the feedlot from becoming polluted. Several specific instances of SCS assistance and planning are cited to illustrate how specific feedlot problems were overcome. Over the years, SCS has built up a knowledge of soils and drainage and altering water pathways. This places SCS in a better position than most to help control runoff from feedlots. (Merryman—East Central)

## 2844 - E3, F2
### RULES AND REGULATIONS REGARDING PROCESSED ANIMAL WASTE PRODUCTS,

Colorado Department of Agriculture
Rules and Regulations Regarding Processed Animal Waste Products, Colorado Department of Agriculture, Division of Inspection and Consumer Services, Feed Section, 1973, 6 p.

Descriptors: Regulation, Legal aspects, Colorado.
Identifiers: Processed animal waste products.

These are the rules and regulations regarding processed animal wastes products. Legal-authority for these regulations is found in Title 35, Article 60, Section 107, Colorado Revised Statutes 1973, as amended. Definitions are given for: (1) animal waste, (2) processed animal waste, (3) processed, (4) dried poultry waste, (5) dried poultry litter, (6) dried ruminant waste, (7) undried processed animal waste product, (8) processed animal waste derivative, (9) person, and (10) references to statutes of agency rules or regulations. The following matters are outlined: (1) Registration Required, (2) Registration Procedure, (3) Registration Refused, (4) Quality Standards, (5) Labeling Requirements, (6) Testing Required, (7) Records Required, (8) Registration Revocation, Suspension, Annulment, Limitation or Modification, (9) Deviation from rules, (10) License and Bond Requirements, (11) Liability and Penalties, and (12) Effective Date and Duration of Regulation. These rules became effective on November 19, 1975. (Merryman-East Central)

## 2845 - A11, C2, E2, E3, F1
### VALUE OF POULTRY WASTE AS FEED, FERTILIZER DISCUSSED,

Feedstuffs editor
G. Emerson
Feedstuffs, Vol. 47, No. 41, p. 22, October 6, 1975.

Descriptors: Feeds, Fertilizers, Poultry, Proteins, Nutrients, Nitrogen, Potassium, Phosphorus.
Identifiers: Dried poultry waste, Dried layer waste, Dried poultry litter, Refeeding.

A workshop recently held in Corona, California, considered the pros and cons of poultry waste utilization as feed or fertilizer. Among the points made were the following: (1) While manure was once low in phosphorus, improved rations have now made phosphorus one of manure's most valuable ingredients. (2) Fresh or dried poultry manure is a good source of nitrogen, but animal manures and composted or stockpiled chicken manures are not. (3) Manure can best be utilized where nitrogen phosphorus and potassium are needed—such as potassium and phosphorus-deficient areas planted in cotton or potatoes or in phosphorus-deficient areas in small grain or range production. Chemical nitrogen would still need to be added. (4) Limitations of dried poultry manure as fertilizer include the following: (a) Excessive application rates must be utilized to combat the problem of irregular distribution; (b) As a nitrogen source, dried poultry manure does not release nitrogen quickly enough for some crops; (c) Dried poultry manure supplies too much nitrogen for some crops and not enough for others. (5) Dried layer waste and dried poultry litter have nutrient values of $97 and $80 per ton, respectively, and have shown themselves to be satisfactory food supplements for ruminant animals. (6) Crude protein values are fairly high in DPW but much of the nitrogen is non-protein and of fairly limited use to non-ruminant animals such as poultry and swine. However, experimental results have suggested that levels of up to 10-12 percent DPW can be used in layer rations without significant effect on production, feed efficiency or egg size. (Merryman-East Central)

## 2846-B2, C2, E2, F1

### WHAT'S THE REAL VALUE OF LIQUID DAIRY MANURE?,

Illinois University
D. H. Vanderholm
Hoard's Dairyman, Vol. 120, No. 7, p. 505, April 10, 1975.

Descriptors: Dairy industry, Nutrients, Fertilizers.
Identifiers: Liquid dairy manure.

Fertilizer nutrient content and fertilizer value of liquid dairy manure are estimated in relation to current fertilizer prices. One gallon of liquid dairy manure contains about 0.024 lb N, 0.014 lb $P_2O$ , and 0.025 lb $K_2O$, respectively. The value of these major nutrients in one gallon of liquid dairy manure is 1 cent per gallon. Because nutrient content of manure varies and because fertilizer prices may go up, dairy owners must have their own dairy manure analyzed and compared against current fertilizer prices to get a true estimate for themselves. (Merryman-East Central)

## 2847 - A11, B1, C2, E3

### WASTE REFEEDING SEEN AS COST OFFSETTER.

Feedstuffs Southeastern Correspondent
R. H. Brown
Feedstuffs, Volume 47, No. 50, p. 5, 45, December 8, 1975.

Descriptors: Costs, Performance, Cattle, Poultry
Identifiers: Refeeding, Crop residues, Animal wastes

Speaking at a conference concerned with utilization of plant and animal waste in livestock feeding, Dr. R. L. Vetter of Iowa State University proclaimed crop residues and animal waste to be valuable feed sources. He described tests at Iowa State University in which cattle wastes were scraped twice weekly from a confinement building; mixed with weighted amounts of ground cobs, ground corn and molasses in a silage wagon; and blown into a silo for ensiling. Ingredients percentages were: excreta, 42; stover and cobs, 42; and ground corn and-or molasses, 15. Cattle fed the excreta-stover silage in a 100-day feeding test gained 197 lb, compared to 31 lb for cattle fed a balanced control ration of ground hay, cobs, and molasses estimated to provide 10.3 lb of total digestible nutrients per cow daily. Those head on excreta-stover silage consumed 28 to 30 lb of dry matter per day with free-choice feeding. No health problems were observed during the 5½ months tested. At this same meeting, Edward McCaugh of Morton, Mississippi, reported an experiment in which he fed his calves a mixture containing 12-15 percent corn, 60 percent poultry waste and 25-30 percent soybean stalks that had been run through a hammermill. No-till corn is also being looked at as both a cattle feed and a soil conservation practice. (Merryman—East Central)

## 2848 - A11, B1, C1, C2, F5, F6

### WATER QUALITY IN A RECIRCULATING RACEWAY SYSTEM FOR FISH CULTURE,

Fisheries Biologist, Entomology and Fisheries Department, Coastal Plain Experiment Station, Tifton, Georgia
Descriptors: Fish farming, Water quality, Recirculated water, Parasites, Rainbow trout
Identifiers: Channel catfish.
T. K. Hill and J. L. Chesness
Presented at 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, Paper No. 73-5508, 14 p. 2 fig, 5 tab, 4 ref.

Four seasons of fish production in an 8-segment recirculating earthen raceway system at the Coastal Plain Experiment Station, Tifton, Georgia, are discussed. Rainbow trout were raised during the winter and Channel Catfish were raised during the summer. Purina Trout Chow was fed twice daily to trout at rates of 2-2½ percent body weight and once daily to Channel Catfish at rates of 1-3 percent body weight. Catfish were parasitically infested by Cleidodiscus, Scyphidia, and Trichodina during the studies. Trout were infested by Gyrodactylas and Trichodina. All conditions were effectively treated with 30 ppm of formalin. Raceway water was periodically sampled and dissolved oxygen, total hardness, pH, $CO_2$, ammonia, turbidity, and visibility were measured. The fish were harvested at the end of each season. Experimental results indicate that recirculating raceways provide an easily manageable (treatment, feeding, and harvesting) production system for fish culture. Year-round fish production in a temperate climate can be accomplished by alternately growing Rainbow Trout and Channel Catfish as described. Eight inch long fingerlings should be stocked so that marketable size fish can be attained in the double-crop system. Maximum fish production capacity was not reached during the two-year study. Water quality was still good by the end of the study. It was felt that natural restorative capacity of the system combined with man-made systems (physical, chemical, biological) should provide water quality suitable for significantly increasing fish production. (Merryman-East Central)

## 2849 - A2, B2, B5, C2, E2

### WATER QUALITY AND MANAGEMENT CHARACTERISTICS OF FEEDLOT RUNOFF HOLDING PONDS,

Agricultural Engineering Department, Illinois University, Urbana-Champaign
E. C. Dickey and D. H. Vanderholm
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4568, 12 p. 6 fig, 3 tab, 8 ref.

Descriptors: Water quality, Feedlots, Agricultural runoff. Illinois. Rainfall-runoff relationships, Nitrogen, Phosphorus, Potassium.
Identifiers: Holding ponds, Land application.

A study was initiated in 1974 to evaluate installed runoff control facilities in terms of their management requirements, operator acceptability, and their effectiveness in preventing water pollution. Six commercial livestock operations in central and northern Illinois—beef, dairy, and swine facilities—were monitored for two years. This paper reports the findings directly related to characteristics and management of the holding ponds. Each runoff control system consisted of a concrete settling basin with a gravity-drain or a pumped outlet, holding pond, and pumping equipment for holding-pond dewatering. Rainfall and runoff data were collected at all the locations. Five holding ponds were sampled monthly; the sixth was sampled weekly. It was found that the quality of holding-pond water is highly variable. Large variations in nitrogen, phosphorus, and potassium concentrations in the water were observed. Nitrogen concentration exhibited a definite seasonal trend: low concentrations during the summer months, increasing in late fall and winter, reaching a peak in late winter, and decreasing in the spring. It was concluded that major factors affecting holding pond water quality are the management of the lot surface, the number of animals in the system, and changes in annual rainfall patterns. In order to gain optimum nutrient benefits, dewatering of the holding pond should occur in the spring. However, dewatering in the fall is still recommended in most situations to provide capacity for winter runoff storage. (Cameron-East Central)

## 2850 - A8, B2, C2, E2

### PLANT AND SOIL EFFECTS OF SWINE LAGOON EFFLUENT APPLIED TO COASTAL BERMUDAGRASS,

Soil Science Department
North Carolina State University
Raleigh
G. A. Cummings, J. C. Burns, R. E. Sneed, M. Overcash, and F. J. Humenik
Paper Number 4649, Journal Series of the North Carolina Agricultural Experiment Station, Raleigh, North Carolina, 17 p. 7 tab, 3 ref.

Descriptors: Effluents, Lagoons, Coastal Bermudagrass, Soil contamination, Agricultural runoff, Seepage, Leaching, Nutrients
Identifiers: Land application, Swine, Plant response

A study was done to (a) determine maximum permissible loading rate of anaerobic swine lagoon effluent upon Coastal bermudagrass grown on a Norfolk sandy loam, and (b) determine the fate of possible pollutants added to soils including crop utilization, soil absorption, and losses due to runoff, seepage, and leaching. In May, 1972, Coastal bermudagrass was established by sprigging on a Norfolk sandy loam, 0 to 3 percent slope after fumigation with methyl bromide to kill all existing vegetation. Weekly application rates of 5, 10 and 20 inches of effluent supplied 300, 600, and 1200 lbs of N respectively. Samples of effluent applied to plots were collected by placing 400 ml beakers within the plot during effluent application. Effluent, runoff, soils, forage, and solution samples from porous cups were all analyzed for total N, P, K, Ca, Mg, Na, Cl, and Cu. Independent analyses were made for other chemical properties as well. It was concluded that application of 24 inches of swine lagoon effluent, supplying over 1400 lbs each of N and K per acre annually, was not detrimental to yield or mineral content of Coastal bermudagrass in 1974. Total amounts of exchangeable P, K, and Mg increased in the soil profile as rate was increased. Changes in total N in the soil induced by treatments were not detected over the two year period. However, nitrate levels were high, up to 28 ppm, in the lower portion of the profile the second year. Although effluent rates increased soil reserves of several elements, no detrimental effects of effluent applications upon plants or soils were noted. More years of application are needed to evaluate long term effects. (Cameron-East Central)

## 2851 - D2, E2, E3, F1

### HOW TAIWAN HOMESTEAD FARMERS MAKE METHANE WORK FOR THEM,

G. Logsdon
Compost Science, Vol. 16, No. 5, p. 30, Autumn, 1975. 1 fig.

Descriptors: Recycling, Methane, Fertilizers, Nitrogen, Economics.
Identifiers: Swine, Taiwan.

The Taiwanese farmer is turning to methane production in order to improve and preserve the fertilizer value of manure. Methane production reduces manure bulk, making it easier to handle. The protein-rich residue contains slightly less nitrogen than the original manure and the manure nutrients are more stabilized, making them far less likely to leach or volatilize in storage or in land spreading. With this approach, the cost of making methane is balanced against the nitrogen saved. A rural development specialist named Chung Po describes simple home methane generators which cost only about $300 to build. The generators run off the digested wastes of 10-15 pigs. Gas production is continuous. The gas contains 63-67 percent methane, 27-33 percent $CO_2$, and 1.7 percent hydrogen sulfide. In hot weather, about 3,000 liters of gas are produced a day—enough for cooking 3 meals a day or to run a 2 kw generator 3 hours a day. (Merryman-East Central)

## 2852 - A11, B2, C2, D3, E3

### RECYCLED MODIFIED SWINE WASTES AS A SOURCE OF PROTEIN, VITAMINS AND MINERALS FOR SWINE,

Animal Science Department, Florida University, Gainesville
H. D. Wallace, N. D. Thanh, G. E. Combs, and R. A. Nordstedt
Research Report AL-1975-4, Florida Agricultural Experiment Station, Gainesville, May, 1975, 6 p. 1 fig, 4 tab, 2 ref.

Descriptors: Performance, Diets, Nutrition.
Identifiers: Refeeding, Swine, Fermented Concentrated Sterilized Wastes.

A small model system was developed at the University of Florida which was capable of converting raw swine wastes into a feed suitable for refeeding to growing-finishing swine. Utilizing this system, swine wastes were fermented, concentrated and sterilized. The fermented liquid product was then substituted for drinking water and used as a supplement to meal diets deficient in mineral, protein, and vitamins. A total of 50 pigs were involved in this feed trial which lasted 6 weeks. The model system was successfully developed to a stage where the raw wastes were recycled through a workable system. However, treatment technique, volume control, changes in mineral concentration and other factors affecting the production of a consistently wholesome product of meaningful nutritional value were not adequately mastered. Pigs offered the fermented concentrated sterilized waste (FCSW) as a supplement to a low mineral diet performed similarly to control pigs on the low mineral diet but not as well as pigs fed a complete diet. The FCSW also failed to improve performance of pigs fed a low mineral, low protein (8 percent) diet. When a low mineral, low protein, low B-complex vitamin diet was supplemented with FCSW, further reduction in feed intake and gains resulted. The conversion of non-protein nitrogen to protein nitrogen was not an efficient process. Procedural changes are needed to improve the conversion. (Merryman-East Central)

### 2853 - B1
### COLD SLATTED FLOOR BARNS...WORK WELL IN SOUTHERN MINNESOTA,
D. W. Bates
Hoard's Dairyman, Vol. 120, No. 23, p. 1340, 1350, December 10 and 25, 1975. 1 fig, 3 tab.

Descriptors: Minnesota, Housing, Design, Dairy industry
Identifiers: Cold slatted-floor free-stall barns, Floors, Frozen manure

The performance of three cold slatted-floor free-stall barns is compared. One barn was at the University of Minnesota and two were independently owned by Minnesota dairy men. All were put to use in 1973 and performed during an extremely cold winter. Though problems arose, results indicated that such systems could be successfully utilized and that problems with frozen manure could be handled with good management. The following advice is given to dairymen considering such a system. (1) Provide a clear opening in the ridge that is a minimum of 6 inches wide. For buildings over 40 feet wide, add 2 inches for each additional 10 feet of building width. (2) Supply either adjustable, trackmounted ventilation doors about 3 feet high and 8 feet long, or tilt-type openings which pivot on a horizontal center support at regular intervals in both long walls. Regulate these openings according to weather conditions. (3) Limit alley width to concentrate animal traffic for effective movement of manure through the floor openings. Alleys between two rows of stalls may be as narrow as 6 feet. Use a width of 9-10 feet for alleys between a feed bunk and row of stalls. (4) Possibly remove manure from immediately behind the stalls by hand or scraper if freezing starts. (5) Follow good management practices essential to the success of any free stall system. (Merryman—East Central)

### 2854 - A11, C1, C2, E3, F2
### COLORADO OKAYS USE OF DPW,
Egg Industry, Vol. 8, No. 12, p. 13-14, December, 1972.

Descriptors: Colorado, Regulation, Chemical properties, Physical properties.
Identifiers: Dried poultry wastes, Processed wastes.

Colorado rules and regulations regarding use of processed animal wastes as feed products became official on October 15, 1975. The rules established that all products, whether dried poultry waste from poultry, litter, dried ruminant waste or processed waste derivative, such as yeast, algae, or other organisms produced from wastes, must not contain more than 12 percent moisture. It must be pathogen-free and must not exceed FDA standards for drug and pesticide residues or other "deleterious" substances. The product must not contain more than 500 ppm as mercury, lead, bismuth, copper, cadmium, arsenic, antimony or tin or in excess of 20 ppb of aflatoxins. DPW must not contain less than 20 percent crude protein or more than 15 percent crude fiber; 30 percent ash; 1 percent feathers, 12 percent moisture or 20 percent litter. Dried poultry litter shall contain no less than 18 percent crude protein or in excess of 40 percent crude fiber or 30 percent ash or 5 percent feathers or 12 percent moisture. Dried ruminant waste must contain no less than 12 percent crude protein or no more than 30 percent crude fiber, or 30 percent ash, or in excess of 40 percent straw, wood, wood shavings, litter, dirt, sand, rocks or other extraneous material, or in excess of 12 percent moisture. Copies of these regulations are available from: Division of Inspection & Consumer Services, Colorado Department of Agriculture, 406 State Services Bldg., 1525 Sherman St., Denver, Colorado 80203. (Merryman-East Central)

### 2855 - C2, D3, F1, F6
### ENERGY SOURCES FOR BIOLOGICAL DENITRIFICATION OF ANIMAL WASTES,
Agricultural Engineering Department
Delaware University
Newark
W. F. Ritter and R. P. Eastburn
Presented at 1975 Annual Meeting, American Society of Agricultural Engineers, University of California, Davis, June 22-25, 1975, Paper No. 75-4041, 6 p. 5 tab, 7 ref.

Descriptors: Denitrification, Animal wastes
Identifiers: Energy sources, Methanol, Molasses, Composted solid waste, Barriered landscape water renovation system

A 5-month laboratory experiment was conducted to evaluate methanol, molasses, and composted solid waste as energy sources for denitrification of animal wastes when applied to a barriered landscape water renovation system. Soil columns from acrylic plastic pipe were constructed with a length of 183 cm and 10.2 cm in diameter. Prior to applying waste to the soil columns, each column was leached with 3 liters of distilled water. All of the effluent from each column was collected and analyzed for COD, organic nitrogen, ammonia, and nitrate-nitrite nitrogen. Conclusions drawn were: (1) Molasses was the most suitable of the energy sources tested. (2) Composted solid waste would not make a suitable energy source for a BLWRS because of the organic matter and nitrogen that may be leached from it. (3)Molasses is more economical than methanol as an energy source for a BLWRS. (Cameron—East Central)

### 2856 - A5, A6, A8, B3, C2
### INTACT MANURE PACKS HALT SEEPAGE,
Hoard's Dairyman, Vol. 120, No. 18, p. 1087, September 25, 1975.

Descriptors: Feedlots, Odors, Cattle, Seepage control, Rainfall.
Identifiers: Soil pollution, Groundwater pollution, Manure packs.

A four-year research project has shown that cattle feedlots do not pollute soil and groundwater if they have an intact manure pack and about one animal per 200 square feet. Scientists of USDA's Agricultural Research Service have found that an intact manure pack eliminates water infiltration and movement of contaminants through the soil to the groundwater. Fred A. Norstadt and Harold R. Duke conducted a study utilizing commercial and experimental feedlots without concrete floors. To gather data on water content and chemical movement, the researchers installed three cased dry wells in one of the feedlots and a similar well in a nearby alfalfa field. Nitrate nitrogen concentration was found to be highest near the manure-soil interface. This nitrogen concentration decreased markedly with depth. Nitrate nitrogen content in the water table under each well fell into the same range as had been determined in 1912 before feeding operations were established. In relation to odor, Norstadt theorizes that odors produced by feedlots can be reduced and partially controlled by such improved management practices as using sawdust and wood chips for bedding and stirring the manure pack. A special feedlot was built at CSU's Animal Science Research Center to test what effect such practices would have on water, salt and nitrogen movement beneath a feedlot. One year of testing has shown that proper management results in no pollution hazard to soil or water beneath the feedlot. (Cameron-East Central)

### 2857 - A11, C2, D2, E3
### FLORIDA RESEARCH FINDS MILK PRODUCTION UNAFFECTED BY 10 PERCENT DPW IN COW'S RATIONS,
Feedstuffs Southeastern correspondent
R. H. Brown
Feedstuffs, Vol. 47, No. 46, p. 4, 52, November 10, 1975. 1 tab.

Descriptors: Florida, Dairy industry, Performance, Calcium, Phosphorus.
Identifiers: Dried poultry wastes, Refeeding, Swine, Oxidation ditch-mixed liquor.

In University of Florida feeding trials, excreta obtained from 50,000 laying hens was dehydrated to a product of ten percent moisture or less. Four rations consisting of 0, 10, 20, and 30 percent DPW were substituted for citrus pulp and fed to 24 lactating cows, using a fixed amount of 30 percent cottonseed hulls as the main crude fiber plus small amounts of urea to balance the protein content. The waste was the only source of calcium and phosphorus supplementation in the 10, 20 and 30 percent DPW rations. Concentrate mixtures were balanced to 13 percent crude protein on an air-dry basis. It was found that DPW levels of up to 10 percent could be used by the cattle with little or no reduction in feed intake and milk production. The DPW can also serve as a source of calcium and phosphorus. A reduction in fat percent for the 10 percent DPW appeared to be the result of citrus pulp reduction. Dr. J. P. Fontenot, reporting on other studies, made the following observations: (1) Limited work indicates that layer waste ensiled with a dry feed such as grass hay will produce a nutritious feed. (2) Limited research has revealed that good performance may be obtained in swine which are fed oxidation ditch-mixed liquor from swine manure when compared with tap water. (3) While high heat processing of cattle waste appears to lower digestibility, addition of such chemicals as sodium hydroxide, improves digestibility. (4) Level of waste to be used in the ration depends on the level of production of the animals. Those in low production, such as pregnant beef cows, could be possibly fed close to 100 percent DPW whereas for fattening cattle the level would likely be 10-25 percent of the total ration. (5) The high protein and phosphorus content of poultry wastes would make them valuable as range supplement for cows and stocker cattle. (6) Waste recycling could save at least 40 million tons of grain annually. (Merryman-East Central)

### 2858 - A5, A8, B2, C2, E2
### EXCESSIVE MANURE CAN AFFECT POTABLE WATER,

Hoard's Dairyman, Vol. 120, No. 13, p. 799, July 10, 1975
Descriptors: Groundwater pollution, Pennsylvania, Regulation, Dairy industry
Identifiers: Land application, Application rates

Five years of experiments were made to determine what happens under Pennsylvania soil and crop conditions when concentrated operations use the land for manure disposal. Dairy manure slurry was injected under orchard grass sod at rates of 120-600 tons per acre yearly for three years. The lowest rate supplied 700 lbs of nitrogen per acre per year. Two years after the applications were discontinued, Penn State researchers still found nitrate nitrogen in the soil water in excess of 10 milligrams per liter, the potable water standard. This was found at 4 feet, where the lowest rate had been applied. Fifty to eighty tons of slurry per acre, supplying 300-500 lbs of nitrogen per acre, were injected in November, 1973, and in April, 1974, to compare fall and spring applications of more moderate applications. Nitrate nitrogen from the fall application had moved down four feet in soil water by June of 1974 but remained near the potable standard of 10 milligrams per liter after July. The nitrate nitrogen from the spring-applied manure never exceeded 10 milligrams per liter during the growing season. (Merryman-East Central)

## 2859 - A11, E3, F2

## DPW SHOWS WIDE VARIATION IN COMPOSITION,

Poultry Digest, Vol. 34, No. 405, p. 437-438, November, 1975. 2 tab.

Descriptors: California, Regulation, Microorganisms, Heavy metals.
Identifiers: Dried poultry wastes, Refeeding, Drugs.

While the state of California has passed regulations permitting the refeeding of dried poultry wastes (DPW), there may still be a basis of concern for allowing such refeeding. Bruce Boyer of the California Department of Food and Agriculture has revealed that there are two categories of control that may not meet tolerances—microbial count and heavy metals. Boyer has stated that when manure is properly pasteurized, there do not appear to be any pathogenic organisms or parasites, but there is a great variation in the microbiological plate count, ranging from 600 to 8,500,000 organisms per gram. The maximum allowed is 20,000. The great variation in metals is also a cause for concern. Against a maximum allowance of 0.1 ppm, selenium has ranged from .62 to 2.6 ppm. The levels of zinc, iron and mercury found in dried poultry wastes are now coming under scrutiny. (Cocon-East Central)

## 2860 - B2, B4, E1, E2, F1

## COSTS OF MANURE DISPOSAL ON DAIRY FARMS IN TENNESSEE,

Agricultural Experiment Station, Tennessee University, Knoxville
H. A. Henderson and L. L. Bauer
Bulletin 514, Agricultural Experiment Station, Tennessee University, May, 1973, 18 p. 11 tab, 16 ref.

Descriptors: Costs, Waste disposal, Dairy industry, Tennessee, Lagoons, Irrigation
Identifiers: Manure, Liquid system

The objective of this study was to estimate the initial investment requirements, annual variable or operating costs, and labor requirements of the 4 systems of manure disposal most often used on Tennessee dairy farms — lagoon, liquid, conventional, and irrigation systems. Throughout the analysis, manure was considered as only a nuisance with no value as a fertilizer. The initial investment requirements per cow were found to be $21.86 for the conventional system, $60.50 for the liquid with 15 days storage, $77.15 for the irrigation system, $86.00 for the liquid with 30 days storage, $97.59 for the lagoon, and $111.50, $137.00, $162.50, and $188.00 for the liquid systems with 45, 60, 75, and 90 days storage. The annual costs per cow were estimated as $9.54 for the conventional, $14.11 and $16.15 for the liquid systems with 15 or 30 days storage, $17.82 for the lagoon, $18.19 for the liquid with 45 days storage, $18.42 for the irrigation system, and $20.33, $22.27, and $24.31 for the liquid systems with 60, 75, and 90 days-storage. If it is desired that the manure be treated as having some fertilizer value, the cost figures can be reduced by $14.25 per cow per year for the conventional, irrigation, and liquid systems. However, the costs for these systems will also be increased due to the necessity of spreading manure over a wider area. Labor requirements for the lagoon system were lowest since no labor was required beyond scraping. Labor requirements for the other systems were essentially the same. Selection of a system to use depends on the particular situation, but should take into account the relative availability of resources, particularly capital and labor. (Cameron-East Central)

## 2861 - A3, C2, E2

## RUNOFF CHARACTERISTICS FROM MANURED FIELDS,

Department of Agricultural Engineering, Cornell University, Ithaca, New York 14853
R. E. Muck, A. G. Hashimoto, D. C. Ludington, and R. D. Black
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-2560, 24 p. 8 fig, 4 tab, 15 ref.

Descriptors: Agricultural runoff, Chemical properties, Ammonia, Nitrates, Flow rates, Phosphates.
Identifiers: Field spreading, Poultry manure, Nitrogen.

The effect of flow rate on the concentrations of ammonia, organic nitrogen, nitrate and soluble phosphate found in the runoff from land to which partially dried poultry manure had been surface applied was investigated. The five experimental plots studied were Langford channery silt loam soil, having a fragipan at a depth of 0.5 to 1 m. Chicken manure taken from a high rise house, egg-laying operation was applied to four plots, while the fifth plot was given no manure or fertilizer. Surface runoff was collected in a plastic lined channel located above a tile drain. Water from the surface channel and tile drain entered a gauge house where flow rates were measured. For each major event, the concentration of a particular parameter from a sample was plotted versus the corresponding flow rate. None of the parameter concentrations showed any correlation with flow rate. (Cameron-East Central)

## 2862 - B5, C1, D1, F6

## DRYING CHARACTERISTICS OF BROILER AND CAGED LAYER WASTE ON A HEATED CONCRETE SLAB,

Environmental Engineer, Environmental Protection Division, Georgia Department of Natural Resources, Atlanta
H. C. Gillespie and B. D. McLendon
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4564, 22 p. 7 fig, 3 tab, 6 ref.

Descriptors: Air temperature, Moisture content, Georgia
Identifiers: Drying characteristics, Broiler waste, Floor temperature, Relative humidity, Poultry waste,

An examination was made of the drying characteristics of broiler waste under controlled environmental conditions existing in an experimental broiler house. Research was conducted to: (1) determine the average vapor diffusion coefficient of poultry waste, (2) determine the effect that the floor temperature, air temperature and air humidity has upon the drying rate of poultry waste material on a heated concrete floor, (3) present an equation to predict the moisture content of poultry waste at a given time during the drying process, and (4) present guidelines for drying poultry waste material in an environmentally controlled poultry house. Experimental procedures are described. It was concluded that (1) the diffusion coefficient for the broiler waste is dependent upon its temperature, (2) the drying process for broiler waste cannot be adequately described by the equation $Y2 = A + B \text{ Log } X$ (Y-Moisture content; X-Time; A,B-Constants), (3) the equation $MC = AT^{b}$ (MC-Moisture content; A,B-Constants, T-Time) adequately describes the drying process, with the appropriate coefficients, (4) equilibrium moisture is an important factor in the drying of broiler waste, and (5) stirring of the broiler waste material can significantly decrease the time required for drying of the material to a satisfactory moisture content. (Cameron-East Central)

## 2863 - A2, B1, C1, C2

## PHYSICAL AND CHEMICAL PROPERTIES OF OUTDOOR BEEF CATTLE FEEDLOT RUNOFF,

Agricultural Engineer, U. S. Department of Agriculture, Nebraska University, Lincoln
C. B. Gilbertson, J. R. Ellis, J. A. Nienaber, T. M. McCalla, and T. J. Klopfenstein
Research Bulletin 271, Agricultural Experiment Station, University of Nebraska, Lincoln, August, 1975, 16 p. 2 fig, 11 tab, 16 ref.

Descriptors: Physical properties, Chemical properties, Feedlots, Agricultural runoff, Nebraska, Design criteria.

In August, 1968-December, 1972, systems were constructed at the University of Nebraska Field Laboratory to study feedlot runoff and its control. Continuous flow systems, a batch system, and pairs of feedlots with a buffer strip between each pair were established. Automatic samplers were installed at all locations to obtain composite samples of runoff from each feedlot and of effluent discharged from each debris basin. Physical and chemical analyses were performed. Total, fixed, and volatile solids transported in rainfall runoff averaged 1.52, 0.84, and 0.68 (percent w.b.) respectively. Solids transported in rainfall runoff were 28 percent filtrable solids. The volatile solids portion decreased with a decrease in particle size while the particle density increased. The unit weight of runoff was 63.02 lb per cu ft. Settleable solids transported in runoff and discharged from the debris basin to the holding pond averaged 217 and 63 cu ft per acre-inch (60, 760, and 17,640 ppm) respectively. Bulk density of the settleable solids in runoff and discharged from the debris basin to the holding pond averaged 10.72 and 8.03 lb per cu ft respectively. Seventy-one percent (by weight) of the settleable solids settled within the first 15 minutes under static conditions. Runoff COD ranged from 14,100 to 77,100 mg/l in snowmelt runoff and 1300 to 8200 mg/l for rainfall runoff. Total N and P concentration in rainfall runoff averaged 916 and 361 ppm, respectively. Average values were 2105 and 292 ppm for snowmelt runoff. Solids transport and settling characteristics data may be valuable in calculating detention times and storage capacities for solids settling facility design. Results can also be used to calculate solids accumulations in holding ponds to estimate maintenance requirements. Feedlot runoff should be restricted from freely flowing into streams. (Merryman-East Central)

## 2864 - F2

## EPA PROPOSES NEW FEEDLOT REGULATIONS,

Wallaces Farmer, Vol. 100, No. 23, p. 9, December, 1975.

Descriptors: Regulation, Legal aspects, Feedlots, Animal wastes, Water pollution.
Identifiers: Environmental Protection Agency.

EPA proposals for new regulations for feedlot permits are advanced for scrutiny. Under the proposals, a feedlot operator will need a waste water discharge permit if: (1) Measurable wastes are discharged directly into any navigable waters that cross the feedlot. (2) Measurable wastes are discharged into navigable waters through a manmade drainage structure. (3) His operation includes more than: 1000 slaughter and feeder cattle, 700 mature dairy cattle, milking or dry, 4500 slaughter hogs, 350,000 feeder pigs, 12,000 sheep or lambs, 55,000 turkeys, 180,000 laying hens, 290,000 broiler chickens. (4) The operation is designated as a significant pollution source by EPA or state water pollution control agencies. If a feeding operation includes a waste control system that keeps wastes from discharging into navigable waters, such as a pit or lagoon, a permit probably won't be needed. (Merryman-East Central)

### 2865 - B2, C2
### FERTILITY CONTENT OF FLUID MANURE FROM MAINE DAIRY FARMS,

Department of Plant and Soil Sciences, Maine University, Orono
J. R. McKenna, C. S. Brown, and P. N. Carpenter
Bulletin 703, Life Sciences and Agricultural Experiment Station, University of Maine, January 1973, 16 p. 1 fig, 10 tab, 20 ref.

Descriptors: Dairy industry, Maine, Fertility, Chemical properties, Nutrients.
Identifiers: Liquid dairy manure.

Studies were conducted to determine the fertility content of fluid manure from tanks in continuous use on three dairy farms. Samples were collected for chemical analyses at intervals over a period of one year (1968-1969). Macronutrient (N, P, K) data were obtained for a total of 33 samplings, and micronutrient data from 8 of these. The following conclusions were made: (1) Nitrogen content on a dry matter basis ranged from 1.42 to 2.91 percent, with an overall mean of 2.06. (2) Phosphorus content of manure dry matter ranged from 0.29 to 1.02 percent, with a mean of 0.52. (3) Potassium content ranged from 1.36 to 3.67 percent, with a mean of 2.50. (4) Mean values for secondary nutrients in manure dry matter were 0.64 percent calcium and 0.31 percent magnesium. (5) Mean values for five micronutrients on a dry matter basis were: manganese 144 ppm, zinc 100 ppm, copper 43 ppm, boron 24 ppm, and molybdenum 4 ppm. (6) The dry matter percentage of fluid manure fluctuated widely, ranging from 6.2 to 12.9 percent, with a mean of 9.5. (7) Nutrient content on a volume basis proved especially variable, considering the extremes in dry matter percentage and the nutrient level of dry matter. Nitrogen (N) may range from 7 to 28 lbs. per 1,000 gallons, phosphorus (P) from 1 to 10 lbs., and potassium (K) from 7 to 36. Mean values were 16 lbs. N, 4 lbs. P, and 19 lbs. K (McKenna-Maine University)

### 2866 - A2, A4, A5, B1, F2
### PREVENTING WATER POLLUTION FROM TURKEY OPERATIONS,

University of California Area Farm Advisor-Turkeys, Parlier, California
J. P. Schroeder
Poultry Digest, Vol. 34, No. 400, p. 240-241, June, 1975. 3 fig.

Descriptors: Water pollution, Poultry, Design criteria, Construction, California, Regulation.
Identifiers: Turkeys.

The California Regional Water Quality Control Board has prepared a survey of the turkey industry in the state to determine its status in relation to state and federal water quality regulations. Questionnaires are going to the turkey growing firms, the contractors, and they are responsible for getting the forms filled out for each of their growers. Sample questions are cited. The California regulations require turkey growers and poultry men to keep water runoff or excess water from their turkey and poultry operations on their farms or to dispose of it in such a manner as not to contaminate the subsurface water or the surface water of their neighbors and create a hazard to public health. For a number of years, turkey growers in central California have been building new facilities or remodeling old ones to conform to the requirements to prevent pollution of public waters. Growers have replaced older narrow shelters of the shed roof type with gabled-roof buildings, which have more height and width. Most of the construction has steel framing. (Cameron-East Central)

### 2867 - A4, A5, B1, E2, F1, F2
### AN ANALYSIS OF DAIRY WASTE MANAGEMENT ALTERNATIVES FOR SOUTHERN CALIFORNIA DAIRYMEN,

Farm Advisor, Los Angeles and Orange Counties, California
F. F. Smith, S. E. Bishop, W. W. Wood, Jr., J. C. Oliver, W. C. Fairbank, and C. L. Senn
Agricultural Extension Service Publication, University of California at Riverside, November, 1973, 14 p. 5 fig, 2 tab.

Descriptors: Dairy industry, Costs, Animal wastes, Water pollution, Density
Identifiers: Waste management, Southern California, Porter-Cologne Water Quality Act

This publication analyzes the impact of the Porter-Cologne Water Quality Act, and suggests the conditions under which the Southern California dairy industry can remain and be competitive with other dairy regions capable of supplying the market. Regulations designed to prevent pollution of surface and underground waters will require new management decisions for most Southern California dairymen. The requirements of compliance are: (1) contain and dispose of all polluted water on land owned or controlled by dairymen, and (2) limit the application of dairy wastes to each acre of cropland to that produced by 1.5 to 5 cows. Alternatives to each of these requirements are also listed. Eight factors which bear on the selection of these alternatives are (1) land values, (2) taxes on land, (3) cow density (or manure application) limitations imposed by water quality control agencies, (4) cow density limitation imposed by local governmental planning authorities, (5) production responses attributable to geographical region, (6) production responses attributable to the side effects of waste management facilities (heat, cold, mud, rain, injury, insects, disease), (7) operating costs attributable to various waste management systems, (8) net revenue realized from cropland used for waste disposal. A method of assessing the effects of these many variables is presented. (Cameron-East Central)

### 2868 - D1, E3, E4
### MANURE IS NOT A DIRTY WORD,

Calf News, Vol. 13, No. 10, p. 30-31, 46, October, 1975. 3 fig.

Descriptors: Recycling, Cattle, Feedlots, Byproducts, Colorado, California.
Identifiers: Refeeding, Soil conditioner, Fuel, France, Mexico.

In Sterling, Colorado, Ceres Ecology Corporation, is recycling cattle manure by breaking it down into four by-products. Much of this work is accomplished by use of the Gaynor separator. The separator completely separates a 70 percent manure slurry into solid and liquid fractions. This eliminates expensive dehydration of manure. The first product recovered in this recycling process is Cereco 1, a silage material of mostly fiber and grain particles. Cereco 1 is fermented and fed daily to steers in 2-pound portions. The second by-product, Cereco 2, is a protein supplement pelleted in ¼ inch diameter pellets. Minerals, vitamins, and antibiotics are added to complete the supplement. Cereco 2 is fed to chickens, trout, and cattle. Cereco 3, the third by-product, is a soil conditioner which may be used as a replacement for peat-moss. Cereco 4, the final product, is a fuel. It is rated at about 7000 BTU's per pound, about the same as low-grade coal or wood. It is low in sulfur and leaves very little ash. Ceres will begin a chicken-manure recycling plant very soon. Ceres also has a feedlot and recycling plant in Toulouse, France, and Ceres is building a recycling plant in Mexico. (Cannon-East Central)

### 2869 - A2, B2, B4, B5, C1, C2, C3, E2
### QUALITY VARIATION OF FEEDLOT RUNOFF IN STORAGE,

U.S. Department of Agriculture, Agricultural Research Service, Lincoln, Nebraska
C. L. Linderman and J. R. Ellis
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-2583, 18 p. 9 fig, 2 tab, 10 ref.

Descriptors: Feedlots, Agricultural runoff, Waste storage, Water quality, Nutrients, Chemical properties.
Identifiers: Holding ponds, Land disposal.

Studies of the Agricultural Research Service, in cooperation with the Nebraska Agricultural Experiment Station, Lincoln, were performed to determine the effluent changes of runoff stored in holding ponds. Feedlot runoff effluent stored in holding ponds may vary in composition due to solids settling, microbial activity, evaporation, and dilution by direct rainfall. These factors had the greatest effect on runoff which was stored with no additions of new runoff. Solids, nitrogen, phosphorus, and salts varied twofold to threefold. When no new runoff was added, NH -N varied sevenfold and electrical conductivity varied ninefold. If it is desired to efficiently utilize the nutrients in feedlot runoff in land disposal, chemical analyses should be performed periodically. This should foster better utilization of nutrients and should arm the feedlot operator in controlling soil salinity. (Merryman-East Central)

### 2870 - A11, C2, C3, E3
### NUTRIENT AVAILABILITY FROM SWINE WASTES COMPARED,

J. D. Kendall, (ed)
Feedstuffs, Vol. 47, No. 45, p. 12-14, November 3, 1975.

Descriptors: Nutrients, Diets, Absorption, Retention, Proteins, Antibiotics, Energy.
Identifiers: Dried swine feces, Oxidation ditch liquor.

At Michigan State University, tests were conducted on absorption and retention of critical elements by dried swine feces and oxidation ditch liquor (ODL). Dietary protein and energy values of the diets were also measured. Pigs consuming either form of waste had increased fecal output. Nutrient absorption and retention from dried swine feces were less than that from fortified corn-soybean meal rations. Digestible protein and energy values of the dried swine feces were low, which limited their use in pig rations. ODL did not influence apparent absorption and retention of nutrients from the ration as much as dried swine feces did. Nutrient availability in the ODL diet, with the exception of calcium, phosphorus, and zinc, appeared to be adequate for finishing pigs. Availability of nutrients from ODL seemed to be better than that from dried swine feces, but less than that of most nutrients in fortified corn-soybean meal finishing rations. No pigs consuming recycled wastewater showed signs of respiratory or gastroenteric problems, however, there was evidence of greater infestation with parasites. One trial tested the influence of dietary antibiotics (Chlortetracycline, sulfamethazine, and penicillin) on growing or finishing pigs receiving only fresh or recycled waste as drinking water. The drugs did not stimulate food intake, but did improve efficiency of gain. Overall, when using only recycled waste as drinking water, feed protein levels could not be reduced. Vitamin levels should not be reduced, but mineral levels could be. Feeding of antibiotics resulted in growth stimulation similar to the stimulation of pigs receiving fresh water. (Cannon-East Central)

### 2871 - A2, F6
### SAMPLERS FOR MONITORING RUNOFF WATERS,

Department of Agricultural Engineering, Kansas State University, Manhattan
H. L. Manges and C.C. Nixon

Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-2562, 10 p. 4 fig, 9 ref.

Descriptors: Agricultural runoff, Sampling, Equipment, Design, Performance

A proportional sampler using short tubes to divide runoff flow was designed, built and tested at Kansas State University. In laboratory tests, sampling ratio became constant after decreasing with increasing flow rates for unsubmerged flow and was constant for submerged flow. Sampling ratio was quite variable during field testing due to debris clogging the reservoir below the short tubes. A sampler using orifices surrounded by short tubes in place of the short tubes alone for dividing flow had a slightly better sampling ratio for unsubmerged flow and a constant sampling ratio for submerged flow. Additional research and development is needed to perfect the design and construction of the proportional sampler. However, it has the potential for wide use in runoff monitoring when perfected. (Merryman-East Central)

## 2872 - A8, C2, E2

### RESPONSE OF ORCHARDGRASS TO BROILER LITTER AND COMMERCIAL FERTILIZER,

Agronomy Department, Agricultural Experiment Station, Division of Agriculture, University of Arkansas, Fayetteville
L. H. Hileman
Report Series 207, Agricultural Experiment Station, University of Arkansas, Fayetteville, April 1973, 18 p. 4 fig, 9 tab. 13 ref.

Descriptors: Orchardgrass, Fertilizers, Nutrients, Arkansas, Application rates, pH.
Identifiers: Broiler litter, Forage response.

The objective of this study was to determine the effectiveness of broiler litter relative to commercial fertilizer as measured by the yield and chemical composition of orchardgrass forage, and the effect on the chemical properties of the fertilized soil. Broiler litter at rates of 0, 2, 4, 6, and 8 tons per acre and equivalent amounts of N-P-K fertilizers were applied annually to the experimental site located in Benton County in the Ozark Highlands of Northwest Arkansas. Soil tests made at the end of the three years of litter application showed a depression of soil pH and available calcium. Soil tests should be used to determine time and rate of lime applications needed to adjust soil pH and calcium levels. The 2- and 4-ton rates of broiler litter supplied adequate plant nutrients for high forage yields and increased the levels of soil phosphorus and potassium. (Cameron-East Central)

## 2873 - C1, C2, D2, E2, E3, F1, F6

### PATHOCIDE SYSTEM TREATS RECYCLED MANURE,

Calf News, Vol. 13, No. 11, p. 16, 42, November, 1975.

Descriptors: Chlorine, Potassium, Phosphorus, Fertilizers
Identifiers: Processed bovine waste, Pathocide unit, Pathocide chemical

Corral Industries of Phoenix, Arizona, has developed a Pathocide Unit which destroys pathogens and stabilizes processed bovine waste (PBW). This unit, fully automatic, meters food process grade chemicals into the PBW. The unit also jointly meters chlorine and pathocide chemicals into the solids. Chlorine provides initial fast pathogen kill and the pathocide chemical provides residual kill, thus stabilizing the solids so they can be stored without composting or heating. John Merten, of Merten Land and Cattle Co., Holtville, California, has recently installed one of these pathocide units. Merten feeds his cattle a high percentage of chopped hay and hay cubes. This high roughage increases PBW recovery by approximately 15 percent. The 3500 head of cattle at his lot produce 21 tons of PBW (solids) for refeeding with a moisture content of 70 percent. The projected value of the PBW is $114,975 annually, based on the value of PBW at $15 per ton. The liquid recovered from the PBW in the dewatering process is very valuable as a fertilizer. Merten stores the liquid in ponds and pumps it directly into his irrigation ditches. The estimated value of nitrogen and phosphorus is $140,000. In areas where the soil is low in potassium, the value of all three elements could rise to $250,000. The projections are based on actual production data from Merten and on estimates based on research findings by Corral and others. (Cannon-East Central)

## 2874 - A8, B1, B5, C2, E2

### UTILIZATION OF ANIMAL WASTE AS FERTILIZER,

Animal Sciences Department, Purdue University, West Lafayette, Indiana
A. L. Sutton, J. V. Mannering, D. H. Bache, J. F. Marten, and D. D. Jones
Publication ID-101, Cooperative Extension Service, Purdue University, West Lafayette, Indiana, 1975. 10 p. 3 fig, 6 tab.

Descriptors: Fertilizers, Crop response.
Identifiers: Land application, Application rates, Waste management.

The purpose of this publication is to provide the livestock producer with pertinent information concerning handling, storage, and use of animal waste as a fertilizer source. The following are discussed: (1) factors which affect the nutrient value of waste, (2) nutrient use by various types of crops, (3) how to determine waste application rates and the need for supplementary fertilizer, (4) how to obtain an animal waste analysis, (5) how to estimate the fertilizer potential of waste from a particular enterprise, and (6) suggestions for proper land application. (Merryman-East Central)

## 2875 - A8, A11, E2

### MANAGEMENT PRACTICES TO PREVENT ANIMAL HEALTH PROBLEMS ON FESCUE PASTURES HEAVILY FERTILIZED WITH POULTRY LITTER,

Associate Professor of Medicine and Surgery, College of Veterinary Medicine, Georgia University, Athens
D. J. Williams, J. A. Stuedemann, and S. R. Wilkinson
Contribution from the Southern Branch, Soil and Water Conservation Research Division, Agricultural Research Service, U. S. Department of Agriculture, February, 1972, 14 p.

Descriptors: Land disposal, Poultry, Litters, Management.
Identifiers: Grass tetany, Fescue toxicity, Agalactia, Fat necrosis, Nitrate toxicity.

This report presents current recommended management practices for prevention of various problems associated with fertilization of fescue pastures with manure litter. The animal health problems discussed are essentially those associated with intensively managed pastures. The problems discussed are: grass tetany, fescue toxicity, agalactia (absence of milk), fat necrosis, and nitrate toxicity. Prevention techniques are outlined as follows: 1. Grass tetany—(a) Apply no more than 4 tons of poultry litter per acre per year. (b) Increase cow consumption of magnesium. (c) Correct soil deficiencies. (d) Avoid animal stress. 2. Fescue toxicity—(a) Apply no more than 4 tons of poultry litter per acre per year. (b) Change pastures. (c) Use other grasses or legumes. (d) Prevent accumulation of dead fescue. 3. Agalactia—(a) Remove cows from pasture. (b) Supplement grazing with grain and hay daily 4-6 weeks before calving date. 4. Fat necrosis—(a) Apply no more than 4 tons of poultry litter per acre per year. (b) Provide balanced source of minerals. (c) Use other grasses and or legumes. 5. Nitrate toxicity—(a) Use no more than 4 tons of poultry litter per acre per year. (b) Delay use of suspected forage. (c) Use vitamin and mineral supplements. (d) Avoid animal stress. (Cannon-East Central)

## 2876 - A6, D1, D2

### ODORS FROM LIVESTOCK MANURES,

Department of Agricultural Engineering, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca
A. T. Sobel
Information Bulletin 31, New York State College of Agriculture and Life Sciences, October, 1973, 4 p. 4 fig.

Descriptors: Odor, Air pollution, New York, Livestock.
Identifiers: Odor control.

Population expansion into non-urban areas has caused the farmer to concern himself with odor problems resulting from animal wastes. The two general categories of odor are: (1) source odors—odors at the point of origin and (2) ambient odors—odors distributed in the atmosphere. Animal waste odors arise from bacterially produced gases such as ammonia and hydrogen sulfide and from volatile organic compounds. Methods of controlling these odors include ventilation, combustion, absorption, adsorption, masking, and use of additives. Odor control by elimination of the source itself involves providing conditions in the manure unfavorable to the production of odorous compounds. Such control methods include aeration, moisture removal, and good housekeeping techniques. Each of the odor control methods is described in detail. (Cameron-East Central)

## 2877 - A12, C1, C2, D2, D3, E3

### WASTE FEEDING FUTURE MAY DEPEND ON TYPE OF PROCESS,

J. E. Dendall, ed.
Feedstuffs, Vol. 47, No. 43, p. 14, October 20, 1975.

Descriptors: Cattle
Identifiers: Refeeding

According to Dr. L. M. Schake, Texas A&M University animal scientist, research has confirmed that cattle wastes may be refed with success. Fresh waste should be obtained for maximum nutrient availability. Furthermore, combination of fresh waste with other feedstuffs to accomplish reconstitution, controlled fermentation or chemical treatment generally enhances nutrient availability and provides an opportunity to safeguard public health. The following factors must be kept in mind when considering refeeding animal wastes: (1) Composition and contaminants are highly variable, (2) High moisture and-or low nutrient-containing wastes do not generally lend themselves to commercial milling and transportation systems, (3) The Food and Drug Administration does not today sanction waste refeeding, (4) Consumer acceptance of beef produced by waste refeeding may be counterproductive to industry goals, (5) Economical systems-handling and milling equipment for cattle waste must be available, and (6) No closed system of total waste refeeding has been developed allowing all waste produced and harvested to be refed to an equal number and type of cattle. (Merryman-East Central)

## 2878 - B2, D3, F1

### DESIGN CRITERIA FOR TURBINE AIR AERATION OF POULTRY WASTES,

Agricultural Research Service, U.S. Department of Agriculture, Department of Agricultural Engineering, Cornell University, Ithaca, New York 14853
A. G. Hashimoto and Y. R. Chen
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4565, 25 p. 6 fig. 3 tab, 21 ref.

Descriptors: Design, Equipment, Aeration, Poultry, Carbon, Nitrogen, Costs.
Identifiers: Turbine-air aeration system.

The most serious problem with currently available aeration systems is their high energy requirements.

Because the turbine-air aeration system (TAAS) has about twice the oxygen transfer efficiency of oxidation ditches, researchers decided to investigate the applicability of TAAS to commercial livestock operations. Design criteria for TAAS were determined for a 40,000 hen, egg-laying operation. It was found that aeration systems should be designed to provide sufficient oxygen to satisfy the carbonaceous and nitrogenous demand. Systems providing 125-150 percent were found desirable to minimize tank costs and nitrogen losses. Solids retention time of 5 days was an ideal compromise between management, treatment and economic constraints. Optimum mixed liquor total solids concentrations were found to range between 2-3 percent. Annual cost for operating a turbine-air system was about 2/3 that of a comparable oxidation ditch system. Research still needs to be done to find a means for eliminating high water requirements and foaming problems. (Cannon-East Central)

## 2879 - A11, C2, E3

## A NOTE ON THE APPARENT DIGESTIBILITY OF ENERGY AND PROTEIN IN DRIED POULTRY EXCRETA,

School of Agriculture
West Mains Road
Edinburgh, EH9 3JG
B. G. Lowman and D. W. Knight
Animal Production, Vol. 12, p. 525-528, 1970, 4 ref. 4 tab.

Descriptors: Energy, Proteins,Nutrition, Copper, Nitrogen
Indentifiers: Dried poultry excreta, Digestibility, Refeeding

The apparent digestibility of dry matter, organic matter, nitrogen, energy and copper in 5 diets containing 0-100 percent dried poultry excreta was determined in order to gauge the wastes nutritional value. Each diet was fed to 4 wether sheep in a trial of randomized block design. The dried poultry excreta supplied 20·21 percent apparently digestible crude protein and approximately 1·57 or 1·74 Mcal of metabolizable energy per kg dry matter. While the copper content was found to be almost double that of barley, it was concluded that (as far as copper levels was concerned) dried poultry excreta was safe for ruminants and a cheap source of protein. More work is needed to ascertain accurately the metabolizable energy of the material. (Merryman-East Central)

## 2880 - A3, A4, B1, F1,

## CONTROL OF WATER POLLUTION FROM CROPLAND VOLUME I -- A MANUAL FOR GUIDELINE DEVELOPMENT,

Agricultural Research Service, U.S. Department of Agriculture, Washington, D. C.
B. A. Stewart, D. A. Woolhiser, W. H. Wischmeier, J. H. Caro, and M. H. Frere
Environmental Protection Agency Report No. EPA-600-2-75-026a, July, 1975, 111 p. 40 fig, 21 tab.

Descriptors: Water pollution, Agricultural runoff, Pesticides, Nutrients, Non-point source pollution, Farm wastes, Hydrology, Sediment control, Erosion.

Engineering and agronomic techniques to control sediment, nutrient, and pesticide losses from cropland were identified, described, and evaluated. Methodology was developed to enable a user to identify the potential sources of pollutants, select a list of appropriate demonstrated controls, and perform economic analyses for final selection of controls. The information is presented in the form of regional maps, decision flow charts, tables, and brief technical highlights. (Stewart-USDA)

## 2881 - A9, A11, A12, D2, F6

## FEEDING TH 6040 TO CHICKENS: EFFECT ON LARVAL HOUSE FLIES IN MANURE AND DETERMINATION OF RESIDUES IN EGGS,

Chemical and Biophysical Control Lab., Agricultural Environmental Quality Institute, Agricultural Research Service, Beltsville, Maryland 20705
R. W. Miller, C. Corley, and K. R. Hill.
Journal of Economic Entomology, Vol. 68, No. 2, p. 181-182, April 15, 1975. 2 tab, 6 ref.

Descriptors: Feeds, Insecticides, Poultry
Identifiers: Fly control, Thompson-Hayward 6040, Residues, Harmful effects

Studies were conducted utilizing Thompson-Hayward (TH) 6040 to determine its effects on house fly larvae in manure and its retention in chicken tissues and eggs. Fourteen laying hens were fed commercial type rations for 18 weeks. TH 6040 was added to the ration at a level of 50 ppm for 3 weeks. Amounts of TH 6040 were halved each succeeding 3 weeks so that in the final 3 weeks the chickens received only 1.6 ppm. Composite manure samples were taken from treated chickens and from a control group on Monday, Wednesday and Friday of each week. Both samples were put into four 200-g cups and seeded with 25 laboratory house fly larvae. Also, during the third week of each period, eggs were collected from the treated chickens for residue analysis. Eggs were separated by shell color. Minimum concentrations of TH 6040 needed to completely kill houseflies fell between 12.5 and 6.2 ppm. At 12.5 and 6.2 ppm treatment levels, .30 and .23 ppm of TH 6040, respectively, were retained in the brown eggs and 1.0 and .55 ppm, respectively, were retained in white eggs. At each feeding level, concentrations in white eggs were about twice as high as those in brown eggs, probably due to differences in feed intake, egg production, or metabolism of the 2 breeds of chickens tested. The use of TH 6040 as a feed additive depends on finding formulas that will cause a greater portion of it to pass out of the chicken without being absorbed. (Cannon-East Central)

## 2882 - A8, B5, C2, C3, E2

## EFFECT OF INCUBATION AND CONTACT WITH SOIL ON MICROBIAL AND NITROGEN CHANGES IN POULTRY MANURE,

Department of Agronomy, Georgia University
Athens 30602
J. Giddens and A. M. Rao
Journal of Environmental Quality, Vol. 4, No. 2, p. 275-278, 1975. 1 fig, 8 tab, 10 ref.

Descriptors: Incubation, Coliforms, Bacteria, Fungi, Nitrogen, Environmental effects.
Identifiers: Land application, Poultry litter, Ammonia volatilization.

Contamination of the environment from poultry manure is often related to the changes that occur in the material during handling. This study involves some of the microbial and chemical changes in poultry manure, especially nitrogen, that may result from methods of handling. The following laboratory treatments were used to determine microbial changes in manure: 40 g poultry litter; 30 g soil plus 10 g poultry litter; 40 g fresh poultry droppings; 30 g soil plus 10 g fresh poultry droppings; and 40 g soil alone. The materials were either mixed with or surface applied to soil. Moisture was added to approximate field capacity. The "mixed" treatments were incubated at 28° C for 3, 7, 14, 21, and 28 days. It was concluded from these experiments that: (1) Ammonia formed in poultry manure has a drastic effect on reducing the relative numbers of micro-organisms present, including total coliforms, (2) Less nitrates may be formed in soil by frequent manure applications than less frequent applications at the same total rate, (3) surface application of manure results in $NH_3$ volatilization and hence formation of less soil $NO_3$ than when incorporated, and (4) Rapid drying of poultry manure results in less volatilization of $NH_3$ than slow drying. (Cameron-East Central)

## 2883-A4,A5,A6,A7,A8,A11, A12,A13,B1,C1,C2,E2,E3, F4

## FARM ANIMAL MANURES: AN OVERVIEW OF THEIR ROLE IN THE AGRICULTURAL ENVIRONMENT,

Department of Soils and Plant Nutrition, California University, Davis
J. Azevedo and P. R. Stout
California Agricultural Experiment Station Extension Service Manual 44, University of California, Berkeley, August, 1974, 109 p. 27 fig, 29 tab, 401 ref.

Descriptors: Farm wastes, Agriculture, California, Chemical properties, Physical properties, Decomposition, Environmental effects, Fertilizers, Fuels, Waste disposal.

This publication presents an overview of the status of livestock manures, their interrelationship with society as well as agriculturists, the problems they create, and the possibilities they offer as sources of energy and of soil enrichment. Specific topics discussed are: (1) animal manures in California, (2) quantity of manure produced by domestic animals, (3) chemical and physical characteristics of manures, (4) decomposition of manures, (5) nuisance factors of manures, (6) effects of manure on water quality and water-body ecology, (7) animal manures as factors in disease transmission, (8) prejudices regarding use of animal manures, (9) fertilization with manures, (10) manure as a soil amendment, and (11) alternative uses of manures. (Cannon-East Central)

## 2884 - A8, A11, B2, B3, C2, E2

## DAIRY CATTLE MANURE--ITS EFFECT ON YIELD AND QUALITY OF COASTAL BERMUDAGRASS,

Soil Scientist, U. S. Department of Agriculture, Auburn, Alabama
Z. F. Lund, B. D. Doss, and F. E. Lowry
Journal of Environmental Quality, Vol. 4, No. 3, p. 358-362, July-September, 1975. 7 fig, 3 tab, 11 ref.

Descriptors: Dairy industry, Crop response, Coastal bermudagrass, Nitrogen, Solid wastes, Liquid wastes.
Identifiers: Land application, Yield.

Three years of experimental tests were designed to define the quantities of solid or liquid manure that may be applied to a sod without impairing yield or quality of forage produced. Coastal bermudagrass was used as a test crop because it utilizes large quantities of nitrogen, thus minimizing the possibility of groundwater contamination. The average N, P, and K content of the manure, based on 20 samples per year, was slightly under 2 percent N, ½ to 2/3 percent P, and slightly over 1 percent K on an oven-dry (65°C) basis. Liquid manure was more effective than solid manure at an equivalent rate for forage production the first year. Accumulations from continuing applications at the 45 metric tons $ha^{-1}$ $year^{-1}$ rate produced excellent yields of high quality forage the second year on the loamy sand and the third year on the sandy loam. Rates of 45 metric tons $ha^{-1}$ $year^{-1}$ can be used for 3 years without impairing forage quality. Three years' application of manure at rates of 90 and 135 metric tons $ha^{-1}$ $year^{-1}$ was detrimental to the forage. It was felt that application of 135 metric tons $ha^{-1}$ $year^{-1}$ over a period of years could produce Coastal bermudagrass forage with levels of nitrate exceeding tolerance levels for ruminant animals. (Cameron-East Central)

## 2885 - A11, B2, F1

## HYDRAULIC CLEANING OF A NEW BEEF-FLOORING SYSTEM,

Agricultural Experiment Station, Iowa State University, Ames
G. B. Parker, R. J. Smith, and H. L. Self
Presented at the 1975 Winter Meeting, American Soc-

iety of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4555, 13 p. 7 fig, 1 tab, 5 ref.

Descriptors: Confinement pens, Design, Costs, Performance, Iowa
Identifiers: Hydraulic cleaning

An innovative approach to hydraulically handling confinement beef-cattle wastes was developed at Iowa State University Allee Experimental Farm, Newell, Iowa. A system was constructed of precast, hollow-core flat slabs with slots in the top sides of the cores to allow flushing. The flush water passes through the flumes into a collection channel which empties into an anaerobic lagoon. Lagoon liquor flows through a plastic pipe into a wet well. Pumps in a nearby dry well pull from the wet well to recycle water back to the building. The cost of the flooring system, including transportation and foundation preparation, was less than $2.50 per square foot. The recycle system and flushing devices added another $2500. Winter operation of the system proved to be problem-free. At present, no definite conclusions can be drawn concerning differences in cattle performance among different flooring systems. Performance on all floors appears to be equal. (Merryman-East Central)

## 2886 - A11, B1, C2, E3, F1
## RECYCLED MANURE – PRACTICAL SILAGE,

Beef, Vol. 12, No. 1, p. 12-13, September, 1975. 2 fig, 1 tab.

Descriptors: Recycling, Feedlots, Cattle, Silage, Economics, Nutrients, Energy, Fertilizers, Iowa.
Identifiers: Refeeding.

At a recent cattle feeder meeting, nutritionist Wise Burroughs described the Iowa State Method for turning manure into silage. Cattle are kept on solid concrete floors where manure and urine collect. Twice a week the material is removed. To aid in picking up moisture, ground corn cobs or chopped stover is spread on the floor a few hours before removal by the tractor-mounted loader that scrapes up the material. The material is then combined with whole plant corn silage, cane molasses and ground corn and is mixed in a well scrubbed flail type manure spreader for unloading in a bunker silo. In the Iowa State experiment, the material was left in the silo 4 months and then used in feeding trials. Burroughs said that the excreta silage was "indistinguishable from whole corn silage, except that it had no whole grain in it." It had no offensive odor and the cattle ate it readily. The experiments were only at the 98-day point at the time of Burroughs' report. Key conclusions were: (1) Ensiled excreta has nutritional value and can supply the protein and minerals needed by cattle when used in corn-silage type ration, (2) At present prices, excreta silage gives no economic advantage. (3) The material is better than necessary for brood cows and appears to be safe at recycling rates of 50 percent or more, and (4) Chemically, it's about like medium quality hay. Bart Cardon, at another recent cattle feeder meeting, gave less enthusiastic endorsement of refeeding manure. Cardon felt that solids in feedlot waste were less valuable than barley straw. He felt that the liquid part of the wastes was more valuable but that separating the nutrients from the wastes was uneconomical and that disposing of the solids was still a pollution problem. Cardon also criticized recycling of wastes as fertilizers, oil, gas, or electricity for economic reasons. (Merryman-East Central)

## 2887 - D1, F6
## ELUTRIATION OF MANURE AND ASH IN A FLUIDIZED BED.

Department of Chemical Engineering, Kansas State University, Manhattan
C. R. Engler, W. P. Walawender, and L. T. Fan
Report No. 62, Institute for Systems Design and Optimization, Kansas State University, Manhattan, Kansas, December, 1974, 54 p. 14 fig, 10 tab, 9 ref.

Descriptors: Elutriation, Manure, Ash, Fluidized bed.

Experiments were made with a fluidized bed simulation unit to observe bed behavior under operating conditions approximating those estimated for the manure pyrolysis process. Under selected conditions, the bed operated as a slugging bed; however, addition of Koch static mixers to the bed broke up the gas slug and reduced bed fluctuations. Elutriation rate data were obtained for sand, manure, and ash and were compared to existing elutriation correlations. Although agreement between the experimental values, and the correlations were poor, the correlations were found to be in error for the smaller particle sizes. An extrapolation procedure was developed which gave improved agreement for smaller particle sizes. (Cannon-East Central)

## 2888 - A4, F2
## WETZEL V. A. DUDA AND SONS (ACTION BY RIPARIAN PROPERTY OWNERS TO ENJOIN WATER POLLUTION TO LAKE FROM FARMING OPERATIONS),

306 So. 2d 533-534 (4th D.C.A. Fla. 1975)

Descriptors: Trespass, Judicial decisions, Water pollution, Lakes, Farm wastes, Common law, Legal aspects, Riparian rights, Equity, Land tenure, Water law, Water pollution sources, Florida, Riparian land, Wastes, Farms, Chemical wastes, Agricultural chemicals, Chemicals
Identifiers: Injunctive relief, Intentional torts, Nuisance (Legal aspects), Hazardous substances (Pollution), Non-point sources (Pollution)

Plaintiffs, riparian property owners on a lake, brought an action against a nearby farming operation for an injunction to abate water pollution and for damages. Defendants were polluting the lake by discharging noxious chemical and other substances from a nearby farming operation. Plaintiffs alleged that their riparian rights were injured by the defendant's creation of a nuisance, that defendants breached their duty to conduct their farming operation in such a manner as not to injure plaintiffs, that the defendants were engaging in a continuing trespass, and that the actions of the defendants were willful and malicious. The trial court dismissed the action for failure to exhaust their administrative remedies under the Environmental Protection Act. The Fourth District Court of Appeal of Florida reversed and remanded holding that the action was predicated on the right to abate nuisance, continuing trespass, and continuing breach of duty; therefore, the property owners were not required to exhaust administrative remedies before seeking injunctive relief. (Fernandez-Florida) (Abstract only)

## 2889 - A3, A8, C2, E2
## NUTRIENT LOSSES IN SURFACE RUNOFF FROM WINTER SPREAD MANURE,

Department of Agricultural Engineering, Wisconsin University, Madison
J. C. Converse, G. D. Bubenzer, and W. H. Paulson
Presented at the 1975 Annual Meeting, American Society of Agricultural Engineers, University of California, Davis, 1975, Paper No. 75-2035, 11 p. 1 fig, 6 tab, 10 ref.

Descriptors: Agricultural runoff, Nutrients, Precipitation.
Identifiers: Nutrient losses, Land spreading.

Nutrient losses from 10 alfalfa fields were monitored for 3 years. These fields were 3.0 m by 13.2 m and had slopes ranging from 10 to 12 percent. Dairy cattle manure was applied to 2 of the fields in the fall, winter, and spring of each year. The remaining 4 fields had no nutrients added. Runoff was collected from the fields at the end of each runoff event and daily during snow melting periods. The average amount of rainfall for the three years was 105.4 cm, 107.8 cm, and 108.8 cm respectively. About 12 percent of this was snow. The average runoff was 13.6 cm in the control field, 7.3 cm in the fall field, 10.4 cm in the winter field, and 10.6 cm in the spring field. The reason for the greater runoff in the control field was that it had less ground cover and fewer earthworms than did the manured plots. There were no significant differences in nutrient losses in the test fields and in the control fields, although yearly variations were exhibited. (Cannon-East Central)

## 2890 - A8, C2, E2, F1
## MANURE CAN COMPETE WITH COMMERCIAL FERTILIZER,

J. F. Blair
Feedlot Management, Vol. 17, No. 7, p. 20, July, 1975.

Descriptors: Fertilizers, Feedlots, Texas, Rates of application, Nitrogen, Salts.
Identifiers: Land application.

Texas High Plains feedlots are now selling their manure for use as fertilizer. Dr. B. A. Stewart examines the pros and cons of using such wastes on croplands. Factors to be considered before buying feedlot waste are: (1) price comparison between manure and fertilizer, (2) soil type, (3) kinds of crops, and (4) amount of irrigation water. Six tons of dry feedlot waste will make available about 120 pounds of nitrogen the first year, and this is about the amount needed on irrigated crops. The second year the available nitrogen drops to 45 percent, 8 percent, and 4 percent the following years. Because there is no economical way to apply manure to get the exact amount of nitrogen needed, Stewart recommends that farmers apply 10 tons every third year where available and supplement this with commercial fertilizer the following 2 years. This would prevent the dangers associated with applying too much manure—nitrate build-up, salt build-up, and stunting of crops. While heavier soils effectively utilize the nitrogen in manure, more porous soils utilize phosphorus as well. Stewart estimates that 5 steers will produce enough manure to cover an acre at the rate of 10 tons. (Cannon-East Central)

## 2891 - A8, C1, E2, F6
## DETACHMENT OF SOIL AGGREGATES BY SIMULATED RAINFALL FROM HEAVILY MANURED SOILS IN EASTERN NEBRASKA,

Professor of Agronomy, Nebraska Agricultural Experiment Station, Lincoln
A. P. Mazurak, L. Chesnin, and A. E. Tiarks
Soil Science Society of America Proceedings, Vol. 39, No. 4, p. 732-736, July-August, 1975. 3 fig, 3 tab, 13 ref.

Descriptors: Soil aggregates, Rainfall, Environmental effects, Soils, Nebraska.
Identifiers: Land application.

A field experiment was established to measure (1) the detachment of soil particles and aggregates by simulated rainfall as affected by various amounts of manure applied annually, (2) the size distribution of aggregates and particles in the splash, and (3) penetrometer resistance of crust formed on the surface by the impact of waterdrops. Effects of incorporating manure into the soil by disk plowing to depths of 10, 20, and 30 cm on stability of soil mass was measured under simulated rainfall conditions. It was found that: (1) Aggregates from manured plots were separated more easily by the impact of simulated raindrops because of reduced cohesion in these aggregates as compared to those from nonmanured plots. (2) The aggregates from manured soils were less dense than those from nonmanured soils because of the low density of the manure. Therefore, less energy was required for detachment of the aggregates with manure from the soil surface as compared to aggregates without manure. (3) Soil crust strength was reduced by the additions of manure. The protective seal on the surface did not form readily and the amount of soil detachment by simulated raindrops remained large. (Cameron-East Central)

## 2892 - A11, C2, C3, E3, F2
### DPW STILL HAS TO BE SOLD,
R. C. Hartman
Poultry Digest, Vol. 34, No. 401, p. 276, July, 1975.

Descriptors: Feeds, California
Identifiers: Dehydrated Poultry Waste, Marketing, Public reaction

Despite the fact that dehydrated poultry waste (DPW) is a low cost method of putting extra pounds on cattle, poultry men have found very little market for their product. California approved the use of DPW in cattle feeds in July, 1974, and since then four firms have been licensed to produce it. Two of the four firms have found a market for DPW, but livestock feeders are in no hurry to buy it. They are afraid of the public reaction to the waste. The feedlots that do use DPW feed only a 5 percent ratio, far less than hoped for. The big problems with DPW at present are high bacterial levels, high concentrations of lead, copper, selenium, and ash and low protein value. The manure must be dried within 24 hours after being produced to keep down bacteria. Spores that are resistant to drying temperatures carry over to the finished product. Even though DPW is a valuable ruminant feed, it will be difficult to overcome public reaction. (Cannon-East Central)

## 2893 - A11, E3, F1
### CHICKEN MANURE: WORTH ITS WEIGHT IN CORN,
V. Ehmke
Progressive Farmer, Vol. 90, No. 6, p. 19, June, 1975. 1 fig.

Descriptors: Feeds, Poultry, Economics.
Identifiers: Poultry litter, Silage.

Some cattlemen in North Georgia have found that finishing cattle on poultry litter silage (PLS) is the cheapest way to get their animals to market. Daniel Whitlock and his brother-in-law Dennis Nichols of Toccoa, Georgia, have found that they can cut their feeding costs to about 16 cents per pound of gain by feeding PLS with corn silage. When their cattle reach about 800 pounds, they gradually add hammered corn until the ration is 60 percent corn. At this ratio, the average cost of gain is about 33 cents per pound. Roy Holtzclaw, of Cumming, Georgia, finishes his cattle on corn silage and high-moisture corn but feeds dry poultry litter and PLS for low cost gains before the cattle go into the lot. During the last year, Holtzclaw has been ensiling the litter in a trench silo. Instead of mixing the litter and corn in one silo, he keeps one silo for litter only. Holtzclaw is convinced this is the best way to feed the litter and to make low cost gains on his cattle. (Cannon-East Central)

## 2894 - C2, D2, D3, E3, F6
### DAIRY MANURE DEGRADATION UNDER MESOPHILIC AND THERMOPHILIC TEMPERATURES,
Agricultural Engineering Department, College of Agricultural and Life Sciences, Wisconsin University, Madison
J. C. Converse, J. G. Zeikus, R. E. Graves, and G. W. Evans
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4540, 16 p. 1 fig, 7 tab, 15 ref.

Descriptors: Dairy industry, Waste treatment, Temperature, Degradation (decomposition), Chemical properties, Anaerobic digestion.
Identifiers: Loading rates, Detention times.

Anaerobic degradation studies for maximum methane production were conducted at 35 degrees C and 60 degrees C on 3 types of dairy cattle manure at different detention times. The 3 types of dairy manure and detention times were: feces - 15 days at 35 degrees and 60 degrees C; feces-urine-straw - 15 days at 35 degrees and 60 degrees C; and feces-urine mixture - 10.4 days at 35 degrees C and 6.2 days at 60 degrees C. The manure was diluted with equal parts water giving a volatile solids concentration of about 6.5 percent. Loading rates ranged from 4.18 to 10.28 kg VS/m$^3$ of digester volume. Gas yield ranged from 1.53 to 1.88 m$^3$ gas/m$^3$ reactor volume for the mesophilic and from 1.04 to 2.34 m$^3$ gas/m$^3$ reactor volume for the thermophilic digester. Average percent $CH_4$ ranged from 53.1 to 57.2 percent for the mesophilic digester and from 49.2 to 54.1 percent for the thermophilic digester. Gas yield ranged from .801 to .924 m$^3$/kg VS destroyed for the mesophilic digester and from .657 to .792 m$^3$/kg VS destroyed for the thermophilic digester. The percent volatile solids reduction dropped from 41.8 percent at 15 day detention time for feces-urine-straw mixture to 29 percent at the 10.4 day detention time for feces-urine mixture for the mesophilic digester. For the thermophilic digester, percent VS reduction dropped from 40.8 percent at 15 day detention time for the feces to 28.9 percent for 6.2 day detention time for the feces-urine mixture. Over 95 percent of the total nitrogen was accounted for in the effluent. Average $NH_3$/TN ratio of manure was .30. Average $NH_3$/TN ratio of effluent was .42. Over 91 percent of the total phosphorus and potassium were recovered in the effluent. $NH_3$ in the off gas ranged from an average of .0075 to .014 m/1 of gas. $H_2S$ in the off gas ranged from an average of .79 to 2.55 mg/1 of gas. Methogenic bacteria numbers averaged $10^8$ and $10^{10}$ in the mesophilic and thermophilic digesters, respectively, during the evaluation of the feces-urine mixture. Net energy, based on percent of gross energy, ranged from 67 to 74 percent for the mesophilic digester and from a minus to 44 percent for the thermophilic digester. (Converse-Wisconsin University; Merryman, ed.)

## 2895 - A2, A6, B1, B2, B3, B4, E2, F1, F2
### AN ECONOMIC APPRAISAL OF ALTERNATIVE DAIRY WASTE MANAGEMENT SYSTEMS DESIGNED FOR POLLUTION CONTROL,
Agricultural Economist, Farm Production Economics Division, Economic Research Service, U.S. Department of Agriculture, Michigan State University
J. B. Johnson, C. R. Hoglund, and B. Buxton
Journal of Dairy Science, Vol. 56, p. 1354-1366, October, 1973. 8 tab, 27 ref.

Descriptors: Dairy industry, Economics, Agricultural runoff, Feedlots, Confinement pens, Liquid wastes.
Identifiers: Waste management, Land spreading.

Enforcement of existing and proposed legal environmental controls will necessitate adjustments in manure handling practices on many dairy farms in the United States. The cost of these adjustments will depend on dairy herd size and type of production system currently in use. Stanchion or stanchion-switch systems generally would have an excercise lot and/or a feeding lot exposed to precipitation. Runoff can be controlled by diverting around lots uncontaminated waters from areas above the lots and directing lot runoff into a detention facility. Similar control facilities could be used for open-lot housing systems. Runoff from manure spreading operations can be reduced by applying manure to soils only twice a year. Each measure mentioned requires the addition of a storage facility. Open-lot systems which use a tractor scraper-loader-spreader system for daily manure spreading can add a storage facility or can convert to a tractor scraper-lagoon-aerator-irrigation system. Covered housing systems which currently use solid manure handling systems can usually add storage facilities to eliminate daily field spreading. Covered housing using liquid manure handling systems can add a mechanical scraper to the conventional tractor scraper-storage-loader-liquid-spreader. To eliminate field odor problems in liquid manure spreading, soil injector units can be added to liquid spreaders. Some of these adjustments will reduce costs, but most will increase costs and reduce net dairy income. (Cannon-East Central)

## 2896 - B1, B2, E4
### HYDRAULIC MANURE REMOVAL FROM DAIRY FACILITIES,
Extension Agricultural Engineer, Cooperative Extension Service, Washington State University, Pullman
R. E. Hermanson and M. H. Ehlers
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4554, 9 p. 1 tab, 6 ref.

Descriptors: Design, Dairy industry, Hydraulic systems, Economics, Performance.
Identifiers: Manure removal.

Design details of flushing systems for four dairies in Washington are described. Information gathered was quantity of water used, head of water in flush tanks, gate size, alley slope, alley width, alley length, curb height, volume of manure-water storage tank or lagoon, and frequency of flushing. The 3 dairies using flush tanks had an average flushing water use of 317 liters per cow per day. The performance was not any better for the high flush tanks than for the low flush tanks which doubled as a source of drinking water. Of the limited sizes studied, flushing gate size was unimportant to the performance of the flushing system. The 3 percent alley slope of the 3 systems using flushing tanks was steep enough to provide velocity to clean the alleys. The 1 percent alley slope of the pumped-flushing system with recirculation required more flushing water. The system used 3,028 liters per cow per day with 4 daily flushings. The recirculated, settled manure water was satisfactory as flushing water and had only a slight odor. The dairy waste fiber removed from the settling tank served as an acceptable source of free-stall bedding. Concrete storage tanks are more expensive than lagoons because of the large volume of liquid manure generated by a flush system. The great water requirement for flushing and the large storage requirement make the recirculation of flushing water an attractive alternative. (Cameron-East Central)

## 2897 - A3, A8, C2, E2
### EFFECT OF SOIL-INCORPORATED DAIRY CATTLE MANURE ON RUNOFF WATER QUALITY AND SOIL PROPERTIES,
Soil Scientist, U.S. Department of Agriculture, Auburn, Alabama 36830
F. L. Long, Z. F. Lund, and R. E. Hermanson
Journal of Environmental Quality, Vol. 4, No. 2, p. 163-166, 1975. 3 fig, 6 tab, 14 ref.

Descriptors: Agricultural runoff, Nitrates, Biochemical oxygen demand.
Identifiers: Land application, Soil properties, Rye, Millet.

A study was made on .04 ha plots of Norfolk sandy loam to determine the effects of cattle manure application on the quality of runoff water and soil properties. Gahi-1 pearl millet and Abruzzi rye were grown separately on 2 plots each. Manure was applied to 2 plots at rates of 45 metric tons per ha on a dry rate basis for 3 years. The 2 check plots received 450 kg N, 160 kg P, and 180 kg K ha$^{-1}$ year$^{-1}$. The BOD of the runoff water from manured plots did not exceed that of the control plots. The nitrate levels of runoff water from manured plots were affected very little by either application and all values were less than 5 mg per liter. Nitrates increased slightly in the top 90 cm of the manured plots; organic nitrogen increased only to a depth of 15 cm. Nitrate accumulated in millet forage above the safe level for feeding cattle, but not in the rye forage. Soil pH was increased to a range of 5.7 to 6.6 to a depth of 60 cm by manure application. Organic matter decomposed fairly rapidly and at the end of 3 years only 38 percent of the applied carbon remained. These results indicate that at least 45 metric tons per ha of dairy cattle manure can be disposed of on a Norfolk sandy loam by incorporation into the surface 15 cm of soil for a period of at least 3 years without any appreciable effect on the quality of runoff water or soil. (Cannon-East Central)

### 2898 - A6, B2, D3, F1
### LIVESTOCK WASTE LAGOONS,

Agricultural Engineering Department, Purdue University, Ithaca, New York
D. D. Jones and A. L. Sutton
Department of Agricultural Engineering Mimeo, Purdue University, West Lafayette, Indiana, 1974, 12 p. 6 fig., 2 tab.

Descriptors: Design, Lagoons, Livestock, Costs.

This paper establishes guidelines for the proper design and management of livestock waste lagoons. A lagoon must be large enough to provide sufficient dilution water and detention time so that the bacteria can decompose the manure. Wastes from different species of livestock require different quantities of water. Lagoon depth is dependent upon the type of equipment available for excavation. Anaerobic and mechanically aerated lagoons should be as deep as possible while a second stage lagoon should be no deeper than 6-8 feet. Lagoons should be located adjacent to or near the source of wastes and as far away from the farm home as practical and where prevailing breezes carry odors away from the house. A diversion terrace should be uphill from the lagoon to prevent excess surface runoff from filling the lagoon. Six to eight-inch sewer pipe with driven masonary joints works well for lagoon inlets and outlets. Construction costs can be minimized by using a cut-and-fill technique and building a large portion of the lagoon above ground. Settling basins on the basis of 1 cubic foot of settling basin volume for each 12 square feet of lot area. The Soil Conservation Service and extension personnel can provide more specific information. Fourteen lagoon management guidelines are listed in this paper and also addresses where publications can be obtained concerning lagoon design and operation. (Cameron-East Central)

### 2899 - D1, D3, E3
### DRYING OF DUNG-WATER BY BIOGEN RELEASED HEAT. CONTRIBUTION TO THE NONPOLLUTING DISPOSAL OF WASTE FROM ANIMAL MASS BREEDING STATIONS,

A. V. Hirschheydt.
Wasser und Boden, Vol. 26, No. 8, p. 227-229, 1974, 2 fig., 5 tab, 2 ref.

Descriptors: Drying, Germany, Waste treatment, Waste disposal evaporation, Fertilizers.
Identifiers: Composting.

Manure from livestock raising establishments was digested together with sifting remains from trash compost after intense mixing. In the experiments, 70 to 85 percent of the original water contents was evaporated. The further composting not only made the liquid dung spreadable, but led to an extensive decomposition of useful materials latent in the trash compost. From extremely aqueous manure, a larger amount and good quality of dry fertilizer resulted. (Text in German) (Solid Waste Retrieval System)

### 2900 - A2, A5, B4, E1
### EFFECT OF CATTLE FEEDYARD RUNOFF ON SOIL INFILTRATION RATES,

U. S. Department of Agriculture Water Quality Management Laboratory, Durant, Oklahoma
O. R. Lehman and R. N. Clark
Journal of Environmental Quality, Vol. 4, No. 4, p. 437-439, October-December, 1975. 5 fig., 6 ref.

Descriptors: Cattle, Feedlots, Agricultural runoff, Infiltration rates, Soils, Groundwater pollution.

A compact clay soil from a playa lake and a relatively porous blocky, buried soil, both representative of feedyard runoff holding basins in the Texas High Plains, were treated with clear water and synthesized feedyard runoff to test the effects of runoff on soil permeability. It was found that infiltration rates changed most notably with the buried soil, where the rate decreases from 5 cm hour for clear water, to less than 0.006 cm hour for the synthesized runoff. The addition of the synthesized feedyard runoff quickly reduced infiltration rates in both the laboratory cores and field basins. Rates were reduced to less than 0.006 cm hour in 14 to 20 days in all cores and basins receiving the runoff. Sealing was attributed to clogging at or near the surface because the initial infiltration rate was restored when the top 2 cm of soil was removed. For basins constructed in porous soil material, clay liners decreased the time required for sealing, but did not necessarily change the degree of sealing. One main benefit of a clay liner would be to decrease the total volume of water infiltrated. (Cameron-East Central)

### 2901 - B1, F1
### EXPERIENCES WITH WATER RELEASE DEVICES FOR FLUSHING GUTTERS,

Extension Agricultural Engineer, Kansas State University, Manhattan
J. P. Murphy, M. D. Schrock, and J. K. Koelliker
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4553, 13 p., 10 fig., 5 ref.

Descriptors: Equipment, Liquid wastes, Waste storage, Siphons, Costs.
Identifiers: Flushing, Dump tanks, Water release, Swine.

The concept of flushing animal waste from confinement buildings is rapidly gaining acceptance, particularly in the swine industry. Two different water release devices were investigated for flushing gutter applications—an automatic tipping and righting dump tank and a self-priming 15 inch diameter siphon. Field testing of the siphons revealed five phases of operation during the discharge of the storage volume 475 gallons-Phase 1-Purging of air from under the bonnet which takes two seconds; Phase 2—establishment of full flow, which requires about eight seconds; Phase 3—maximum flow, which is sustained for about 8 seconds until the air-bleed hole is exposed; Phase 4—then begins and continues until air is sucked in under the bonnet and the siphoning action is broken—about 12 seconds, and Phase 5—requires about two minutes to bleed air into the bonnet to equalize the air pressure and water level inside and outside the bonnet. The total costs for materials for each siphon was about $80. Dump tanks have been used for years to release water to flushing gutters. There are three points on the tank that are of great importance in understanding how the tank dumps—the center of gravity of the empty tanks, the pivot point and the center of gravity of the water itself. Figures show the installation and operation of the two water releasing devices. (Cameron-East Central)

### 2902 - B1, D3, F1
### ENGINEERING AND ECONOMIC ASPECTS OF FARM DIGESTERS,

Department of Agricultural Engineering, Missouri-Columbia University, Columbia
D. M. Sievers, J. R. Fischer, N. F. Meador, C. D. Fulhage and M. D. Shanklin
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4541, 11 p., 4 fig., 3 tab, 5 ref.

Descriptors: Aerobic digestion, Anaerobic digestion, Economics, Design, Waste treatment, Anaerobic lagoon, Minnesota.
Identifiers: Swine, Oxidation ditch, Confinement buildings.

The University of Missouri-Columbia in the early spring of 1975 began construction of a new swine confinement research complex consisting of five buildings—laboratory, gestation, farrowing, nursery, and finishing buildings. Management structures that were installed included pits, gutter flushing, oxidation ditches, and anaerobic lagoons. Study objectives were (1) to build a farm-size anaerobic digester using construction techniques and materials available to practicing farmers, and (2) to gain some practical knowledge of the management problems of such a unit. The finishing building housed 320 hogs over a slotted floor. Manure was flushed beneath the slotted floor. The pump used to pump the settled solids to the digester was a German-Rupp Model 12 B2-B self-priming, trash handling centrifugal. A fixed digester volume of approximately 140 cu. m. (37,000 gal.) was chosen which provided variations in loading rates, some gas storage, and potential volume for treating manure from the other buildings on the swine farm. Potential digesters considered were (1) glass lined silo, (2) fiber glass tank, (3) poured concrete tank, and (4) concrete stave silo. The digester chosen for the UMC Swine Complex was a 6 m (19 feet 9 inches) diameter concrete stave silo with a hoppered concrete base and solid concrete roof. Construction and material costs to the present date are given for the UMC Digester. (Cameron-East Central)

### 2903 - A11, B1
### PERFORMANCE OF BEEF CATTLE ON SLATED FLOORS,

Animal Science Department, Tennessee Agricultural Experiment Station, Tennessee University, Knoxville
J. B. McLaren and J. I. Sewell
Tennessee Farm and Home Science Progress Report No. 88, p. 2-4, October-December, 1973, 2 tab, 3 ref.

Descriptors: Performance, Cattle, Design.
Identifiers: Floors, Waste management.

Performance of beef cattle on three types of floors was compared in preliminary feeding trials. Floors compared were: solid-concrete slabs, concrete slats, and aluminum slats. Feed consumption, rateof gain and amount of feed required per 100 pounds of gain were similar for bulls fed on concrete slab and those fed on slatted floors, but feed efficiency was slightly lower for bulls fed on slatted floors. Bulls fed on slatted floors exhibited discomfort during mid-summer. This discomfort resulted in a tendency for bulls to lie down and get up more frequently than normal. Some swelling of the front knees was observed. These preliminary results indicate that cattle can be satisfactorily and efficiently finished for slaughter on slatted floors constructed with either aluminum or concrete slats. (Cannon-East Central)

### 2904 - A2, A4, A6, A12, A13, B2, E2
### WATERWAY CLEANS FEEDLOT RUNOFF,

Beef, Vol. 11, No. 11, p.2, July, 1975. 1 fig.

Descriptors: Agricultural runoff, Feedlots, Nebraska
Identifiers: Runoff control, Field sink, Serpentine waterway

Holding ponds are not entirely satisfactory for handling feedlot runoff. Odor, weed growth, and threat to safety are problems that often accompany their use. Some states do not consider feedlot runoff a water pollution hazard if the runoff flows a relatively long distance overland before reaching a stream. Consequently, USDA's Agricultural Research Service is evaluating two direct disposal systems on farms in Nebraska — "field sink" and a serpentine waterway. The 160 x 325-foot field sink with a 0.1 percent slope was installed between a feedlot and a creek. A one-foot dike was built around it. Feedlot runoff collects in a broad-basin terrace and discharges to the field sink via a riser intake and underground pipe. The system functioned well with above normal precipitation in fall, 1973-June, 1974. Under conditions of severe drought, the sink produced 60 bushels of corn per acre, when much of the nearby crop was a failure. The serpentine or switchback waterway was established below a 3-acre feedlot near Gretna, Nebraska. The waterway zigzags with 8 sharp turns. In effect, the 2,600-foot waterway moves the feedlot back 2,200 feet from a stream that is about 400 feet from the edge of the feedlot. The waterway channel slopes to prevent ponding and is seeded in brome and alfalfa to retard flow. Runoff passes through debris basins before entering the channel. Only a major storm will cause an appreciable amount of effluent to enter the stream. (Merryman-East Central)

## 2905 - A1, B1, D1, D2, D3, E2, E3

### ENERGY, AGRICULTURE AND WASTE MANAGEMENT,

W. J. Jewell, ed.
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975. 540 p.

Descriptors: Energy, Agriculture, Gases, Feeds, Economics, Confinement pens, Anaerobic digestion, Design, Costs, Fermentation, Poultry, Livestock.
Identifiers: Waste management, Land disposal, Composting, Swine.

The following 3 topics were discussed in detail at the Proceedings of the 1975 Cornell Agricultural Waste Management Conference: (1) Energy consumed in food production, (2) Technology and energy costs of pollution control, and (3) Potential for producing energy from agricultural wastes. Of particular note, is the amount of information contributed concerning anaerobic fermentation, and the discussion of this technology in producing energy from wastes. (Merryman-East Central)

## 2906 - B2, E2, F1

### MANURE MANAGEMENT ENERGY CONSUMPTION IN SWINE CONFINEMENT SYSTEMS,

Extension Agricultural Engineer, Agricultural Engineering Department, Maryland University, College Park
H. L. Brodie
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 237-243. 3 tab.

Descriptors: Energy, Confinement pens, Costs, Labor, Economics.
Identifiers: Swine, Oxidation ditch, Open gutter flush system, Land disposal.

A survey was conducted on 2 operating swine confinement systems (an oxidation ditch under a slotted floor and an open gutter flush with water recirculation through a lagoon) to determine the energy utilized for the movement of manure from the feeding floor to land disposal. It was found that when compared to an oxidation system, the flush system provided a considerable reduction in energy, dollars, and labor while effectively performing the primary function of manure removal and disposal. Both systems performed this function within existing environmental constraints equally well. (Cannon-East Central)

## 2907 - D2, D3, E2, E3, E4, F1, F4, F6

### FROM BIODUNG TO BIOGAS--HISTORICAL REVIEW OF EUROPEAN EXPERIENCE,

Institut fur Pflanzenbau and Saatfutforschung, Forschungsanstalt fur Landwirtschaft, Braunschweig-Voelkenrode, West Germany
C. Tietjen
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 247-259. 5 fig, 1 tab, 51 ref.

Descriptors: Recycling, Fertilizers, Gases, Methane, Fermentation, Anaerobic conditions, Economics.
Identifiers: Germany, Biogas plants.

Conversion of manure to gas is reviewed historically, with emphasis on German experimentation. After World War II, Germany had fertilizer and energy shortages. Experimenters were concerned that manure should serve both needs. The question arose as to how anaerobic treatment of manure affected its quality and quantity. A team consisting of 3 groups, constructed 3 different biogas plants. Plant 1, built according to Ducellier and Isman, had 3 cylindrical containers with a capacity of 7.5 $m^3$. Two were covered with a sheet iron lid after loading and the third was completed by a gas holder. Glass wool insulation and a water circulation heating system were installed. Plant 2, built according to Reinhold, had a fermentation chamber of 17 $m^3$. Heating was by steam injection and was found unsatisfactory due to water infiltration into the slag insulation. Plant 3, constructed according to Schmidt and Eggersgluss, but on a smaller scale, consisted of a mixing chamber of 4 $m^3$, a fermentation chamber of 14 $m^3$, a manure storage silo divided into 2 compartments of 8 $m^3$, and a gas container of about 12 $m^3$. Heating was done by steam injection. Later a fourth plant was built, according to Poetsch, by the Technical University of Hanover as a prototype. In field and pot experiments with different crops, fermentation residues and conventionally rotted stable manure were compared on a balance base in order to evaluate the treatment methods. Products of liquid manure practices gave higher yield, contained more plant-available nitrogen, and required lower labor costs than products of solid manure practice. Gas amounts from a cattle manure substrate with great amounts of straw were nearly twice the amounts of similar substrates with less straw. Fermentation at 55 degrees C yielded much gas with a high methane portion in the first period, contrary to fermentations at lower temperatures. While use of animal wastes upon cropland is Germany's optimum goal, methane from manure may become a valuable by-product due to the energy crisis. (Cannon-East Central)

## 2908 - D2, D3, E3, F1, F5

### ENERGY RECOVERY AND FEED PRODUCTION FROM POULTRY WASTES,

Assistant Professor, Agricultural Engineering Department, Maine University, Orono
A. E. Hassan, H. Moustafa Hassan, N. Smith
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 289-305. 10 fig, 1 tab, 21 ref.

Descriptors: Costs, Energy, Methane, Poultry, Algae, Design, Nitrogen, Proteins, Effluent.
Identifiers: Feeds.

A study was conducted to determine optimum conditions for methane production at temperatures of 25.5± 3 degrees C to study effects of depth, aeration, and effluent concentrations on algal yield and to provide preliminary design for a full-scale poultry digestion unit. Fresh caged layer manure was mixed with sawdust at different rates and incubated in 16 one-liter boiling flash laboratory digesters. Water was also added. Inoculum from previously digested effluent was added to all digesters at a rate of 50 percent by volume. Quality and quantity of gases produced were recorded on a routine basis during the process. Green algae, Scenedesmus, were grown in the effluent. The effluent was clarified to allow maximum light penetration. Data showed best results when solid content was 4-7 percent. Above or below that range, methane production declined sharply. The presence or absence of sawdust had little or no effect on methane production. Optimum solids content for a minimum recharging interval is 7 percent. Practically all of the nitrogen from the manure remained in the effluent. The 1 percent treatment provided highest yields and the aerated treatments gave better results than the unaerated. A pond depth of 20 cm provided highest algal yield. Protein content of dried algae flakes varied from 42 to 45 percent. Ten kg of dry waste yielded one kg of algal protein. The 500,000 tons of poultry waste produced in Maine yearly could produce algae protein equivalent to 150,000 tons of soybeans. When algae was fed in barley rations as a replacement for meat and bone meal additives, swine grew and fattened normally. Design criteria for a digester unit are given in detail, along with approximate costs. (Cannon-East Central)

## 2909 - C2, D2, D3, E3, F6

### ANAEROBIC DIGESTION IN SWINE WASTES,

Agricultural Engineer, U. S. Department of Agriculture, Agricultural Research Service, North Central Region, Missouri University, Columbia
J. R. Fischer, D. M. Sievers, and C. D. Fulhage
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 307-316. 7 fig, 2 tab, 6 ref.

Descriptors: Anaerobic digestion, Gases, Design, Antibiotics, Alkalinity.
Identifiers: Swine, Volatile solids, pH.

On January 10, 1974, a pilot plant digester utilizing swine waste as a feed source began operation and was monitored to : (1) evaluate the effect of loading rates on gas production, (2) determine the most stable chemical environment for gas production, and (3) determine the most easily managed, best suited system for measuring digester stability. The digester was a long, cylindrical container supported in a horizontal position. It was first loaded with 16 gallons of digester sewage sludge and 29 gallons of tap water. Influent was gradually increased until a loading rate of 0.04 lb VS/$ft^3$ (0.64 kg/$m^3$) was reached. Digester temperature was maintained at 95 degrees F. On February 22, gas production declined 50 percent and on March 1, ceased, due to the injection of 1 pig with tylosin and lyncomycin. These antibiotics destroyed digester bacteria. Conclusions that were derived from the study were: (1) Gas production rate is the best indicator of digester activity. (2) Stable digestion of swine waste can be obtained at loading rates ranging from 0.15 to 0.18 lb. VS/$ft^3$ (2.33 to 2.86 kg VS/$m^3$). (3) At the loading rate stated above, approximately 16 $ft^3$ (0.45$m^3$) of gas per lb VS destroyed is produced, the pH is 7.3, the ammonia is 1000 ppm (1000 mg/1) and the alkalinity is approximately 6000 ppm (6000 mg/1). (4) The manure of hogs given injections with antibiotics can disrupt digester performance. (Cannon-East Central)

## 2910 - D2, D3, E3, F1, F4

### ALTERNATIVE ANIMAL WASTE ANAEROBIC FERMENTATION DESIGNS AND THEIR COSTS,

Research Specialist and Associate Professor, Department of Agricultural Engineering, Cornell University, Ithaca, New York
G. R. Morris, W. J. Jewell, and G. L. Casler
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 317-335. 6 fig, 5 tab, 22 ref.

Descriptors: Design, Costs, Economics, Fermentation, Anaerobic conditions, Methane, Recycling, Energy, Nitrogen, Phosphorus, Temperature.
Identifiers: Digesters, pH.

Studies were made with the following objectives: to review the status of anaerobic fermentation technology and its application to animal wastes, to apply this technology to develop system alternatives which are compatible with current farm management practices, and to assess the economic feasibility of incorporating the anaerobic fermentation systems into the farm both as an alternative energy source and a waste management practice. Five systems were identified as technically feasible alternatives for stabilization of animal wastes. They were: (1) completely mixed digester operated in the mesophilic range; (2) completely mixed digester operated in the thermophilic range; (3) batch load digesters; (4) partially mixed digester operated in the mesophilic range; and (5) plug flow digester. Design and costs are discussed. Study results showed that more data is needed to provide engineers with information necessary to design workable alternative systems. Efforts to modify municipal sewage treatment plants are necessary in order to provide economically feasible systems for animal production systems. Under present marked conditions, methane production as an alternative energy source for average sized dairies is not economically competitive with other fuels, but might be feasible with larger operations. As a pollution control device, anaerobic fermentation processes may be economically competitive with liquid manure handling and storage systems. (Cannon-East Central)

### 2911 - C2, D2, D3, E3, F6
### COLD WEATHER ENERGY RECOVERY FROM ANAEROBIC DIGESTION OF SWINE MANURE,

Research Engineer, Department of Agricultural Engineering, Manitoba University, Winnipeg, Manitoba, Canada
E. J. Kroeker, H. M. Lapp, D. D. Schulte, and A. B. Sparling
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 337-352. 7 fig, 6 tab, 10 ref.

Descriptors: Anaerobic digestion, Energy, Gases, Ammonia.
Identifiers: Swine, Volatile solids, pH.

Pilot plant anaerobic digestion of swine manure was begun at the University of Manitoba in the late fall of 1974 to assess technical and economical feasibility of energy recovery from livestock manure. The plant consisted of four single-cell digesters which were serviced by a raw manure holding tank equipped with mixing and transfer pumps to facilitate delivery of raw manure at a relatively uniform consistency into the digesters. The digesters were initially seeded with anaerobic digester mixed liquor from a sewage treatment plant. Operations volume of each digester was 2300 liters. Mixed-liquor temperatures for the 4 digesters were maintained at about 35 degrees C. Raw manure influent temperature was 0 degrees C. Digesters A and B were operated at a 15-day solids retention time (SRT) and digesters C and D were operated at a 30-day SRT. Total gas production was higher for digesters A and B than for digesters C and D, but the fraction of volatile solids destroyed was higher for the lower loading rates and higher SRT. Preliminary results from the pilot-plant study indicated that net energy recovery did not occur; however, there were indications that the upper limit of biogas production was not reached. The following conclusions were drawn from the experiment: (1) Process stability was achieved despite adverse environmental conditions within the digesters including high pH (8.0) and high ammonia concentrations (3390-3450 mg/1); (2) Despite relatively high rates of methane gas production, only 50 percent of the energy expended was recovered through gas production at the loading rates used in these initial experiments; and (3) Rational conductive heat-transfer theory accurately predicted energy requirements for digester heating. (Cannon-East Central)

### 2912 - D3, E3, F1, F5
### ENERGY AND ECONOMIC ANALYSIS OF ANAEROBIC DIGESTERS,

College of Environmental Sciences, Wisconsin University, Green Bay
T. P. Abeles
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 353-360. 12 ref.

Descriptors: Energy, Anaerobic digestion, Economics, Algae, Fish, Hydroponics, Hydrogen
Identifiers: Solar Energy, Biogas

In the summer of 1974, Wisconsin University built a small field model (3-4 cows) anaerobic digestion system to serve as a prototype for a large-scale system. Coincidental with Wisconsin University's construction, a local stable built a full scale system which would handle the output of approximately 100 thoroughbred horses. The close proximity of the 2 systems permitted Wisconsin University to develop a research program to determine: the optimum operating system for use on Midwest dairy farms, the social acceptability of anaerobic digesters as a farm management technique, the feasibility of the establishment of new types of agribusiness, and the impact of anaerobic digesters on utility companies. The 100-horse digester cost about $40,000. Because of several base costs, costs for larger capacity systems would only increase modestly until more digesters are added. By the end of the summer, the small digester was to be equipped with solar panels to test the feasibility of reducing the amount of biogas needed to maintain the digester. An idea was developed for using digester effluent for growing algae or fish. Wisconsin University is exploring the possibility of a leasing operation where the fish farmer would manage several aquaculture ponds utilizing digester effluent as a nutrient base. Farmers interviewed in Brown County, Wisconsin, seemed interested in anaerobic digestion and did not seem to mind the $40,000 price. The major concern of utility companies utilizing biogas or solar plants is that of load leveling of power. If a biogas or solar plant failed, the company must supply the energy from another source. Several routes for combatting this problem are being explored. There appears to be little doubt that biogas plants are economically and operationally feasible. But work still needs to be conducted on standardization of system design and components and on development of a viable service industry. (Cannon-East Central)

### 2913 - C2, D2, D3, E3, F1
### DRY ANAEROBIC DIGESTION,

Assistant Professor Agricultural Engineering, University of Hawaii, Honolulu
G. M. Wong-Chong
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 361-371. 6 fig, 21 ref.

Descriptors: Anaerobic digestion, Poultry, Dairy industry, Sludge, Gases, Methane.

This investigation examined the anaerobic digestion of animal wastes (dairy and poultry) at relatively high solids concentrations (more than 20 percent) in both batch and batch fed reactors at ambient temperatures (70-85 degrees F). This was done in an attempt to circumvent such problems as postdigestion sludge dewatering and treatment of digester supernatant, thus enhancing the economics of the overall process. The following conclusions were made from the information gathered: (a) From fresh dairy manure 11.3 to 13.0 ft$^3$ of digester gas was generated per pound of volatile solids destroyed. Methane composition of the gas was 60-65 percent. (b) There is a limit to the amount of volatile solids in a waste which is convertible to gas. (c) Fresh manure has the greater gas potential than aged manure. (d) Ammonia inhibition to methanogenesis would be significant with highly nitrogenous wastes such as poultry manure. (e) Anaerobic digestion of wastes with high solids concentrations is feasible and offers economies in reduced reactor volume, digester sludge handling, and avoids treatment of digester supernatant. (Cannon-East Central)

### 2914 - D2, D3, E3, F1
### TECHNOLOGIES SUITABLE FOR RECOVERY OF ENERGY FROM LIVESTOCK MANURE,

Research Scientist, Waste Control and Process Technology Section, Batelle's Columbus Laboratories, Columbus, Ohio
C. N. Ifeadi, and J. B. Brown, Jr.
Energy, Agriculture, and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 373-396. 9 fig, 6 tab, 24 ref.

Descriptors: Energy, Cattle, Technology, Fuels, Waste treatment, Anaerobic digestion, Hydrogenation, Methane.
Identifiers: Swine, Hydrogasification, Pyrolysis.

The quantity of manure produced from average U.S. dairy, beef, and hog production facilities is too small for an economic recovery of synthetic fuel from the manures. Therefore, efforts to recover fuel economically from animal wastes are being directed to large animal facilities. Fuel may be recovered from animal manure by either biological or thermochemical processes. Biological processes include methane production and biochemical processes for protein and alcohol production. Thermochemical processes include pyrolysis, hydrogenation, and hydrogasification. High moisture content in livestock manure is a prime disadvantage in the application of thermochemical processes. For fuel synthesis, only methane production and pyrolysis hold promise at above 10 tons per day plant capacity. Capital-intensive items in the biological system are the anaerobic digester and the storage tank; the operating cost-intensive items are labor and maintenance. Consequently, process-cost-reduction must focus on these items. Fuel selling prices and the quantity of manure to be processed are important factors in the economic feasibility of the process. Refinement in the engineering-cost analysis made for methane production is recommended. A thorough cost inventory for a pilot anaerobic digestion plant should be made. Although an energy conversion system may be too complex and time consuming for the average farmer, a package plant system for fuel recovery by a private investor may be economically built adjacent to large livestock-production facilities. (Cannon-East Central)

### 2915 - D3, E3
### METHANE-CARBON DIOXIDE MIXTURES IN AN INTERNAL COMBUSTION ENGINE,

Department of Agricultural Engineering, College of Agriculture and Life Sciences, Cornell University, Ithaca
S. Neyeloff, and W. W. Gunkel
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 397-408 6 fig, 13 ref.

Descriptors: Methane, Carbon dioxide, Anaerobic digestion
Indentifiers: Internal combustion engines, Specific power output

A project was conducted to study the characteristics of gas generated from anaerobic digestion as a fuel for internal combustion engines. A high speed CFR engine was used. Valve timing was set at about 900 rpm. Engine timing was about 30 degrees before top dead center and operating coolant temperature was about 195 degrees F for all tests. Data showed that the best results in terms of specific power output (SPO) were obtained at a compression ratio (CR) of 15:1, although at 15:1 and higher, audible knocking occurred. Below a CR of 10:1, SPO dropped rapidly. Methane ignites at fuel to air ratios ranging from 0.065 to 0.185 by volume. The highest SPO was obtained at a fuel to air ratio of 0.10. Output from engines per unit of methane greatly depends on the engine design and the degree of $CO_2$ dilution in the engine. The mixture will not combust if the amount of carbon dioxide is greater than three times the amount of methane. In a typical spark ignited engine, of the heating value of the fuel, only about 20 percent results in mechanical output. (Cannon-East Central)

### 2916 - A8, C2, E2
### LIMITATIONS OF ANIMAL WASTE REPLACEMENT FOR INORGANIC FERTILIZERS,

Department of Agronomy, Georgia University
D. A. Lauer

Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 409-432. 13 tab, 14 ref.

Descriptors: Fertilizers, Livestock, Nutrients, Grains, Nitrogen, Potassium, Phosphorus, Ammonia.
Identifiers: Manure, Land application.

Problems of large quantities of accumulated manure and increasing costs of manufacturing fertilizer have renewed interest in using manure as a fertilizer. In the United States, cattle produce 82 percent of the total manure produced. Two-thirds of the land surface in the United States is used for growing crops and grazing animals. Food and feed grains occupy over 50 percent of the cropland and receive over 50 percent of the United States' fertilizer. Closer integration of cattle production and production of these crops would increase probability of replacing fertilizer with manure. However, use of manure as fertilizer is not without problems. Fertilizer can be formulated to specific nutrients; whereas, manure nutrients must be used together (as they come). This could cause imbalances in nutrients not deficient. Nutrient contents of manure are extremely variable. Water and organic matter, the main components of manure that are nonnutritive, decrease nutrient concentrations and make manure handling characteristics less desirable. Manure produced in confinement could potentially replace about 42 percent of the nitrogen, 29 percent of the phosphorus, and 57 percent of the potassium consumed as fertilizer. Experiments show that, under favorable conditions, 70-100 percent of ammoniacal nitrogen in dairy manure spread volatilizes. Relative to human nutrition, ammonia volatilization from confinement manure amounts to 7.6 kg N/person/year, which exceeds dietary protein consumption for both plants and animals combined. This nitrogen leakage from the nitrogen cycle may be the final determinant of substitutability of manure for fertilizer. (Cannon-East Central)

## 2917 - A8, B2, C2, D3, E2, E3, F1

## WASTE MANAGEMENT SYSTEMS IN RELATION TO LAND DISPOSAL/UTILIZATION,

BacteriologyDivision, School of Agriculture, Aberdeen, Scotland
K. Robinson
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975. p. 443-452. 1 fig, 5 tab, 8 ref.

Descriptors: Waste treatment, Lagoons, Anaerobic digestion, Effluent, Nitrogen, Phosphorus.
Identifiers: Land disposal, Swine, Scotland, Raw wastes, Oxidation ditch.

Studies were made at Aberdeen to compare different waste management-stabilization systems with a system of no stabilization process. Types of waste used were: (1) Swine waste collected and stored in slurry channels. (2) Anaerobic lagoon supernatant. (3) Mixed liquor produced by anaerobic stabilization of lagoon supernatant. (4) Mixed liquor produced by anaerobic stabilization of slurry (17 days). (5) Mixed liquor produced by anaerobic stabilization of slurry (68.5 days). (6) Mixed liquor produced by second-stage denitrification of mixed liquor from (4). (7) Anaerobic digester effluent. It was found that anaerobic stabilization reduced ammonia-nitrogen and increased oxidized nitrogen. Total nitrogen losses occurred in all processes except anaerobic digestion and were greater in second-stage denitrification. Potassium was unaffected by stabilization. Phosphorus was present mainly in suspended solids, which settle out in a lagoon causing a reduction in phosphorus. For the purposes of this study, it was assumed that all wastes were produced by stabilization systems associated with a 1000-head swine fattening unit, that 6000, 3000, and 3000 units of N, $P_2O_5$, and $K_2O$, respectively, were required for crops, and that waste could not be applied during a 6 month winter period. Except for raw waste and digester effluent, wastes were unable to supply crop requirements for nitrogen. Phosphate exceeded crop requirements except in the case of lagoon and lagoon oxidation ditches. Potash was also in excess, assuming that application rates were based on supplying sufficient nitrogen. Based on costs prevalent for Northeast Scotland, costs represented losses of from 2-5 pounds per pig place. Only raw waste recycling showed a profit. (Cannon-East Central)

## 2918 - A11, C2, E3

## PROTEIN AND ENERGY CONSERVATION OF POULTRY AND FRACTIONATED ANIMAL WASTE,

Department of Animal Sciences, Colorado State University, Fort Collins
G. M. Ward and D. Seckler
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 467-474. 2 fig, 2 tab, 13 ref.

Descriptors: Feeds, Proteins, Energy, Poultry, Cattle, Sheep, Trout, Nitrogen.
Identifiers: Refeeding, Soil amendment, Cereco process, Ash.

Ruminant waste contains about 5 g of nitrogen or 30 g of endogenous protein for each kg of feed dry matter consumed. About 50 percent of this protein is microbial protein and 25 percent is tissue cells from the digestive tract. Although of high quality, this protein is mixed with ash and fiber, which are largely indigestible by nonruminants. The waste must be fractionated to increase protein concentrations. The Cereco process, developed by Ceres Ecology Co., separates manure into three fractions: one high in fiber for feeding to ruminant animals, a second high in protein (20-30 percent) for feeding to either ruminants or nonruminants and a third high in ash intended as a soil amendment. Fraction 1 has been evaluated as a feed for cattle and sheep. Fraction 2 has been evaluated as a protein supplement for cattle, sheep, broilers, layers and rainbow trout. Fraction 1 is equal in feed value to average corn silage; fraction 2 approaches the protein value of equivalent amounts of soybean meal. The ability to fractionate a high protein fraction makes possible a fully integrated cycle in which crude protein of poultry manure provides supplemental protein for cattle and the high quality microbial protein of cattle manure supports poultry. The replacement value of corn by fraction 1 and soybean by fraction 2, if all the waste from feedlot and dairy cattle in the United States were processed, is estimated to equal 14 million acres of cropland. (Cannon-East Central)

## 2919 - B2, B3, C2, D1, D2, D3, E3, F5

## PROTEIN PRODUCTION RATES BY ALGAE USING SWINE MANURE AS A SUBSTRATE,

Oregon State University, Corvallis
L. Boersma, E. W. R. Barlow, J. R. Miner, H. K. Phinney, and J. E. Oldfield
Energy, Agricultural and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 475-493. 2 fig, 15 tab, 27 ref.

Descriptors: Proteins, Algae, Feeds, Recycling, Phosphate, Nitrogen, Carbon dioxide.
Identifiers: Swine waste, Substrate, Clarification.

A waste management system is described in which manure is transported hydraulically from a livestock confinement building to a nutrient recovery unit maintained at elevated temperatures by means of cooling water from a power plant condenser. A solid-liquid separator forces the solid fraction into an anaerobic digester, while the liquid flows into basins for the culture of algae. The most encouraging aspect of the studies has been the stability of Chlorella vulgaris 211/8K cultures growing in fresh swine manure diluted to an ammonium nitrogen content of 250 mg/liter. When manure was clarified by filtration through activated carbon and by ferric chloride flocculation in hopes of improving algal growth, the opposite proved true. Light transmission improved, but algal growth slowed down. The superiority of the untreated swine manure was attributed to the higher organic matter content which provided carbon dioxide for algal potosynthesis. The average algal growth rate for a 12-hour photoperiod at 37 degrees C and a retention time of 3.3 days was about 22 g/m$^2$/day. Development of optimum management techniques requires additional experimentation to establish interactions between temperature, light intensity, retention time, and culture depth. Yields of 25 to 30 g/m$^2$/day for a 12-hour photoperiod appear easily attainable. Neither nitrogen nor phosphorus content of wastes appeared to limit algal growth. Nitrate did not accumulate in the ponds due to volatilization and nitrogen recovery by the algae (20-30 percent recovery). Short term feeding trials with rats indicated that the algal material harvested by centrifugation was an excellent protein source. (Cannon-East Central)

## 2920 - C1, C3, D1, D3

## THERMAL AND PHYSICAL PROPERTIES OF COMPOST,

D. R. Mears, M. E. Singley, G. Ali, and F. Rupp III
Energy, Agriculture and Waste Management, Proceedings of the 1975 Cornell Agricultural Waste Management Conference, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., 1975, p. 515-527. 5 fig, 3 tab, 20 ref.

Descriptors: Thermal properties, Physical properties, Density, Compressibility, Pathogenic bacteria.
Identifiers: Composting, Swine wastes, Windrows.

In 1969, large-scale composting of organic waste was researched at Rutgers University. Swine wastes were deposited in windrows up to 2 m high and 3 m wide. The windrows were turned with varying frequencies by means of a commercial composting machine. Other materials were added to the windrows to determine which combinations would compost most rapidly. Addition of 70 percent straw or 25 percent municipal refuse by volume to swine waste was found to add sufficient carbon and bulking properties to reduce composting time to about 4 weeks. Several studies were conducted on specific aspects of the composting process, including: determination of thermal properties of composting materials and changes in these properties during composting, determination of particle size distribution of composting materials and changes that occurred during composting, determination of the compressibility of composted material, and determination of total volume reduction and changes in bulk density of composting materials. Composting material can be regarded as having low thermal conductivity and specific heat. To prevent thermal inhibition of the biological processes, it is necessary to aerate and/or frequently turn the pile. Although particle size is continuously reduced with decomposition, more work is needed to establish a reliable relationship between particle size and stage of decomposition. Compressibility of all samples of completed compost from windrows of swine waste and some additive were not significantly different from each other. However, the finished compost of windrow 8, which was swine waste with no additive, was significantly less compressible. Also, windrow 12, which was composed of swine waste and straw, but was still composting, was significantly more compressible than the others. Figures in the report illustrate volume reduction and changes in bulk density that occurred in the windrows studies. (Cannon-East Central)

## 2921 - A3, A4, C1, C2, E2

## BUILD-UP OF MINERAL CONTENT IN LAKE DARDANELLE AND THE EFFECT ON ZOOPLANKTON,

Department of Biological Science, Arkansas Polytechnic University, Russellville
T. N. Palko
Arkansas Water Resources Research Center, Fayet-

teville, Publication No. 24, 1974, 186 p. 57 fig. 48 tab, 38 ref.

Descriptors: Arkansas, Zooplankton, Eutrophication, Nutrients, Water pollution effect, Poultry, Effluents, Rotifers, Nitrates, Phosphates, Chlorides, Oxygen, Temperature, Carbon dioxide, Productivity, Streams, Hydrogen Ion Concentration, Water chemistry, Reservoirs, Waste disposal, Water spreading, Mineralogy.
Identifiers: Poultry effluents, Lake Dardanelle (Arkansas), Uric acid, Land spreading.

The effects of poultry effluents on water quality of Lake Dardanelle and its feeder streams in West Central Arkansas were studied during three sampling periods in 1970, 1971, and 1972. To determine these effects, the following factors were investigated: (1) Physico-chemical analysis; (2) Zooplankton community identification; (3) Limited phytoplankton studies by the qualitative-quantitative assessment of chlorophylls. Feeder streams of the Lake Dardanelle Reservoir are major contributors of soluble nutrients which are available to primary producers. Their heavy load of poultry effluents is the result of large poultry operations consisting of both chicken houses and turkey ranges which are located in the watershed of these streams. The addition and the retention of these nutrients in the lake are greatly affected by the magnitude of the flow of feeder streams into the lake. The most influential stream is the Illinois Bayou, owing to its size and consistency of flow. Land spreading is the method of disposal of litter from poultry houses. The magnitude of these soluble nutrients in the streams is dependent on several factors. These include (1) soil conditions at the time of the spreading of litter; (2) the period of time for integration into the soil after spreading before the occurrence of the next rainfall in the area which has the capacity of carrying or leaching this material into the stream bed. (Palko-Arkansas Polytechnic University)

## 2922 - C2, D2, E3

### LIVESTOCK MANURE DISPOSAL VIA HYDROGASIFICATION,

Kansas University, Water Resources Research Institute, Lawrence
H. F. Rosson
Kansas Water Resources Research Institute Contribution No. 155, December, 1974, 126 p. 24 fig, 36 tab, 33 ref.

Descriptors: Feedlots, Farm wastes, Waste disposal, Water pollution, Gases, Livestock, Waste water treatment, Energy, Organic compounds.
Identifiers: Hydrogasification, Hydrogasification yield, Optimum water content, Molten salt, Manure disposal, Supplemental energy, Low sulfur gases, Hydrocarbon gases, Batch reactions.

Manure could be an important source of carbonaceous material and its hydrogasification could help solve the water pollution potential of feedlots as well as provide a supplemental energy resource. Manure can be hydrogasified to produce a mixture of low sulfur gases containing principally water, hydrogen, methane, ethane, and carbon dioxide. The yield of hydrocarbon gases in batch reactors is dependent on the reaction temperature and the hydrogen feed to carbon ratio with higher values producing higher yields. The presence of water is beneficial to yield with an optimum initial water content in the manure of about 50 percent. When using a molten carbonate salt reaction medium, the optimum initial water content may be slightly smaller. The hydrogasification thermic yield is defined to be the heating value of the dry product gases minus the heating value of the hydrogen feed per unit mass of manure. At a reaction temperature of 1050 degrees F., a maximum thermic yield of 3700 BTU/lb dry manure occurs at a hydrogen feed to carbon ratio of about 0.25 moles/mole. Use of a salt medium increases hydrocarbon yield slightly and increases thermic yield to a maximum of about 5500 BTU/lb dry manure at a hydrogen feed to carbon ratio of .93 moles/mole. (Rosson-Kansas University)

## 2923 - A11, C3, F6

### BIFIDOBACTERIA FROM THE FAECES OF PIGLETS,

Istituto di Microbiologia Agraria, Universita di Bologna, Bologna, Italy
G. Zani, B. Biavati, F. Crociani and D. Matteuzzi
Journal of Applied Bacteriology, Vol. 37, No. 4, p. 537-547, 1974.

Descriptors: Bacteria.
Identifiers: Swine, Bifidobacteria, Identification, Taxonomy.

This investigation concerned a taxonomic study of the bifidobacteria isolated from the faeces of piglets, based both on phenotypic characters and on their genetic relatedness, measured with a DNA-DNA hybridization technique. A total of 52 piglets 2-6 weeks old, from 19 different farms, was studied. Ninety-five strains of bifidobacteria were isolated. The majority of the strains were identified as Bifidobacterium suis Matteuzzi et. al. Strains that could not be assigned to any known species of the genus were allotted provisionally to 2 unassigned bacterial groups. (Merryman-East Central)

## 2924 - A6, B2, B3, D1, D3, E2, E3

### AUTOMATED SYSTEM DISPOSES OF HOG WASTES,

Progressive Farmer, Vol. 91, No. 2, p. S22, February, 1976.

Descriptors: Aerobic treatment.
Identifiers: Swine, Flushing, Wastewater recycling, Land spreading.

Ohio researchers have built a new 500-pig nursery-to-finishing unit which combines automated flushing, treatment, and recycling to dispose of animal wastes. Hogs inside the building are trained to defecate in open gutters, which are flushed hourly. A sloping screen removes solids for aerobic digestion and deodorization. The digested solids then flow to a tank for later removal by a vacuum tank wagon. Liquids separated at the screen flow into an oxidation ditch for aerobic treatment. The ditch effluent is clarified in a settling tank and then is recycled through the gutters as flushing water. This system controls odors and minimizes the amount of liquid spread on cropland. (Merryman-East Central)

## 2925 - A8, C3, D3, E2

### CHARACTERIZATION OF THE DOMINANT AEROBIC MICROORGANISM IN CATTLE FEEDLOT WASTE,

Northern Regional Research Laboratory, Agricultural Research Service, U. S. Department of Agriculture, Peoria, Illinois
G. R. Hrubant
Applied Microbiology, Vol. 26, No. 4, p. 512-516, October, 1973. 1 fig, 1 tab, 17 ref.

Descriptors: Cattle, Biological properties, Microorganisms, Antibiotics.
Identifiers: Feedlot waste, Corynbacterium.

Feedlots and related sites were tested for the presence of microflora as a basis for potential solutions for waste utilization and pollution control. Corynbacterium was found to be the dominant aerobic microorganism in cattle feedlot waste (FLW), representing 2-70 percent of the total viable aerobic population. Corynbacterium was widespread in FLW except on sites where antibiotics were a regular part of the animals' diet. The organism decreased both in numbers and in percentage of the total population as FLW was diluted in runoff to a field ditch and after application of FLW to cropland or during "composting." Corynbacterium required DL-aspartic acid as its nitrogen source for growth, and individual strains also required or were stimulated by L-tyrosine; acetate served as the carbon source. Amylolytic activity was weak; protease, lipase, and cellulase activities were nil. Despite the abundance of the microorganism, it was felt that the microorganism probably did not decompose the waste appreciably. (Merryman-East Central)

## 2926 - A8, B3, C2, E2

### DISPOSAL OF BEEF-FEEDLOT MANURE: EFFECTS OF RESIDUAL AND YEARLY APPLICATIONS ON CORN AND SOIL CHEMICAL PROPERTIES,

Assistant Professor of Soil Science, Minnesota University, Northwest Experiment Station, Crookston, Minnesota
G. W. Wallingford, L. S. Murphy, W. L. Powers, and H. L. Manges
Journal of Environmental Quality, Vol. 4, No. 4, p. 526-531, October-December, 1975. 8 fig, 3 tab, 9 ref.

Descriptors: Crop response, Feedlots, Waste disposal, Chemical properties, Nitrates, Salinity.
Identifiers: Land disposal, Nutrient uptake, Corn.

A project was established in the fall of 1969 to study the effects of a wide range of yearly and residual treatments of solid, beef-feedlot manure on the growth of furrow-irrigated corn forage composition and nutrient uptake, and on the chemical properties of a Kansas soil. Feedlot waste was applied annually to a silty clay loam soil at rates that after 4 years ranged from 114 to 2,750 metric tons/ha. For 3 years, in the spring and fall, surface soil samples and soil cores were taken. It was found that chemical composition of manure from a single feedlot varied greatly. Average composition (dry weight basis) of the samples collected was 20.5 percent $H_2O$; 0.92 percent N; 0.52 percent P, 1.14 percent K, 0.92 percent Ca, 0.41 percent Mg, and 0.26 percent Na. Electrical conductivities of extracts from saturated pastes of the surface soil samples from plots receiving yearly manure treatments were linearly related to cumulative tons of applied manure. Electrical conductivity values of more than 10 mmho/cm were recorded for the spring samplings. Both yearly and residual manure treatments caused Na and $NO_3$-N to move downward, accumulating to depths of at least 1 m after 3 years. Movement of K and P was restricted to 50 and 30 cm, respectively. Corn-forage yields increased at low and intermediate rates of manure application, but high rates depressed corn yield. Uptake of N and P was depressed by high yearly rates. Yearly rates of 29-68 dry metric tons ha$^{-1}$ year $^{-1}$ produced near maximum forage yields without causing excessive salt accumulation in the soil. (Merryman-East Central)

## 2927 - B2, E1

### DISPOSAL LAGOON,

Soil Conservation Service, Hawaii
Miscellaneous Publication, Cooperative Extension Service, University of Hawaii, Volume 113, p. 7-11, January, 1974.

Descriptors: Design criteria, Lagoons, Waste disposal, Hawaii, Aerobic conditions, Anaerobic conditions, Operation and maintenance.
Identifiers: Effluent disposal.

A disposal lagoon is defined as an impoundment made by constructing an excavated pit, dam, embankment, dike, levee or combination of these for biological treatment of animal waste. This publication establishes, as an engineering standard for Hawaii, the minimum acceptable quality for design, construction, and maintenance of disposal lagoons located to serve predominantly rural or agricultural areas. (Merryman-East Central)

## 2928 - B1, E3, F1

### DESIGN STUDY TO REFEEDING BEEF CATTLE WASTES,

Department of Agricultural Engineering, Colorado State University, Fort Collins
M. L. Stone, R. W. Hansen, and A. L. Frey
Presented at the 1973 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-14, 1973, Paper No. 73-4504, 13 p. 1 fig, 6 tab, 9 ref.

Descriptors: Costs, Cattle, Feedlots.
Identifiers: Refeeding.

The costs of a standard feeding system are compared to the costs of a refeeding system. Thousand head finishing lots with minimum facilities are compared. Because the refeeding system required concrete surfacing of the pens for easy collection of wastes, the refeeding system required a higher initial investment than the standard feeding system. However, the refeeding system was $9,000 per year cheaper to operate based on 1,000 head. The refeeding system was found to be economically feasible. Two factors not considered in this analysis were consumer acceptance and odor reduction. (Merryman-East Central)

### 2929 - A4, B1, D2, D3, E1, E2, E4, F1, F2
### CLEANING THE ANIMAL FARM ENVIRONMENT,

School of Agricultural and Life Sciences, North Carolina State University, Raleigh
F. J. Humenik, M. R. Overcash, L. B. Driggers, and G. J. Kriz
Environmental Science and Technology, Vol. 5, No. 3, p. 984-989, November, 1974.

Descriptors: Water pollution, Legislation, Waste treatment, Waste disposal, Economics
Identifiers: Land disposal

As a result of Federal Water Pollution Control Act amendments of 1972, the EPA has published 2 sets of regulations affecting the animal production industry which establish a permit program and compliance criteria. The National Pollution Discharge Elimination System (NPDES) guidelines and permit form were published in the July 5, 1973, Federal Register, and the effluent limitation guidelines were published in the February 14, 1974, Federal Register. Because food production has increased and fertilizer prices have gone up, land application of feedlot wastes is very desirable. The problem is that feedlots are not always distributed closely enough to cropland to make land disposal economically feasible. Wastes may be handled as solids or liquids. They may be used either in their raw state or they may be pretreated. Among the pretreatment systems discussed are lagoons, barriered landscape water renovation system, solar still-type reactors, ensiling of wastes into wastelage, and production of algae or single-cell protein. All pretreatment alternatives have residues that must be terminally disposed. Ultimate land application of both solids and liquid is most practical for animal producers. Methods for disposing of wastes on land are discussed. Meeting government regulations concerning waste disposal will have economic ramifications. The Economic Analysis of Proposed Effluent Guidelines for the Feedlot Industry concludes that the effects of these criteria upon product price increases or employment would be quite small, while overall production is likely to increase. However, the cost-benefit aspects of any treatment system designed to produce a dischargeable effluent for animal waste, as is commonly done in conventional waste treatment systems, appear most unfavorable at present. (Merryman-East Central)

### 2930 - A11, B1, F1
### COLD CONFINEMENT MOST PROFITABLE IN MINNESOTA TEST,

Beef, Vol. 12, No. 6, p. 81, February, 1976. 1 fig, 2 tab.

Descriptors: Confinement pens, Minnesota, Performance, Economics.
Identifiers: Housing.

Five types of housing were compared at the University of Minnesota Experiment Station. They were: (1) Open lot, allowing 250 square feet per animal, (2) "Conventional", using an outside, concrete lot, plus a shed shelter, (3) A manure scrape building, which allows a manure pack to build. The building includes a scrape alley for cleaning, (4) A cold confinement building with slatted floors, and (5) A warm confinement building with controlled environment and ventilating system. Performance data for the 5 systems, revealed that there were not any huge differences in either gains or feed efficiency. However, according to Minnesota economists, assuming that a feeder kept his lot full year-around, he would get the best return to labor and management from the cold confinement barn with slatted floors. (Merryman-East Central)

### 2931 - A2, A4, C2, C3
### CHEMICAL AND BIOSTIMULATORY PROPERTIES OF CATTLE FEEDLOT RUNOFF,

Division of Environmental Engineering, Utah State University, Logan
D. S. Filip, E. J. Middlebrooks, and D. B. Porcella
Water Research, Vol. 9, No. 5-6, p. 573-579, 1975. 8 fig, 3 tab, 20 ref.

Descriptors: Feedlots, Agricultural runoff, Chemical properties, Algae, Nitrogen, Phosphorus.
Identifiers: Biostimulatory properties, Growth.

Chemical and biostimulatory characteristics of snowmelt runoff from 2 small cattle feedlots were assessed. Nutrient supplements were used to determine the levels at which nitrogen and phosphorus became limiting to algal growth. The study resulted in the following conclusions: (1) Although available nitrogen and phosphorus concentrations may be adequate to support algal growth, the nitrogen: phosphorus ratio in runoff water is the critical factor for determining which element will first become limiting to algal growth. (2) Levels of inorganic nitrogen and phosphorus were sufficient to support excessive algal growth and indicate the serious eutrophication potential of feedlot runoff. (3) Evidence of toxicity to algal growth was found in feedlot runoff, but the effect was removed by dilution. Toxicity would not likely be evident in a receiving stream because of the dilution by the receiving stream. (4) Characteristics of feedlot runoff are highly variable because of temperature, intensity of runoff, topography, and feedlot conditions. (Merryman-East Central)

### 2932 - A6, C2, C3, D3, E3, F6
### CELLULASE PRODUCTION BY *TRICHODERMA VIRIDE* ON FEEDLOT WASTE,

Northern Regional Research Laboratory, Agricultural Research Service, U. S. Department of Agriculture, Peoria, Illinois
H. L. Griffin, J. H. Sloneker, and G. E. Inglett
Applied Microbiology, Vol. 27, No. 6, p. 1061-1066, June, 1974. 3 fig, 4 tab, 12 ref.

Descriptors: Waste treatment, Fermentation, Fungi, Chemical properties, Odor, Protein, Nitrogen.
Identifiers: Cellulase, *Trichoderma Viride*, Refeeding.

Feedlot waste was fermented with the fungus *Trichoderma viride* with consequent reduction of BOD, COD, odor, and organic matter. *Trichoderma viride* utilized two-thirds of the carbohydrate in feedlot waste while elaborating cellulase in quantities comparable to commercial preparations. The fermented waste retained all of the original nitrogen but had 24 percent less organic matter. Because crude protein content of the residue was increased, it was felt that refeeding of this fermented waste as a protein supplement might be feasible. (Merryman-East Central)

### 2933 - A11, A12, B1, C2, D3
### CADMIUM TOXICITY AND METABOLISM IN ANIMALS,

Georgia University, Athens
M. W. Neathery and W. J. Miller
Feedstuffs, Vol. 48, No. 3, p. 30-32, January 19, 1976. 3 tab, 36 ref.

Descriptors: Cadmium, Toxicity, Metabolism, Public Health.
Identifiers: Animal health, Refeeding.

Experimentally-induced cadmium toxicity in cattle and other animals may result in anemia, retarded testicular development or necrosis, enlarged joints, scaly skin, liver and kidney damage, reduced growth, lower milk production and increased mortality. However, cadmium toxicity is seldom a problem in modern livestock production. Although a significant proportion of inhaled cadmium is absorbed, farm animals usually obtain very little from dust or fumes. Generally, feeds contain very little cadmium and only a small portion of that is absorbed. However, borderline toxicity could arise in animals fed recycled waste materials, such as sewage sludge. Although little cadmium is absorbed from the gut, that which is absorbed remains in the body for a long time, primarily in the liver and the kidney. Very little is deposited in muscles or secreted into milk; hence, these are safe for human consumption. (Merryman-East Central)

### 2934 - A11, B3, C2, E3
### BROILER LITTER AS A WINTERING FEED FOR BEEF COWS AND HEIFERS,

K. E. Webb, Jr., J. P. Fontenot and W. H. McClure
1973-1974 Livestock Research Report, Research Division Report 158, Virginia Polytechnic Institute and State University, Blacksburg, July, 1974, p. 125-128. 6 tab.

Descriptors: Litter, Cattle, Sheep, Toxicity, Copper, Performance
Identifiers: Refeeding, Animal health

Two experiments were conducted with ewes to determine the effect of feeding broiler litter on performance. In both experiments, there were no differences in performance of ewes fed 0, 25, or 50 percent broiler litter, but copper toxicity was encountered in the litter-fed animals. The high copper content of the litter was a result of having fed copper sulfate to the chicks utilizing the litter. One experiment was completed and another started at the Shanandoah Valley Research Station to study the long term effect of feeding high levels of litter containing high levels of copper to cows and heifers during the winter. High copper rations did not affect cattle performance. Liver copper levels were elevated by the feeding of such rations, but copper toxicity did not result. Heifers fed litter rations tended to gain more than those fed control rations. (Merryman-East Central)

### 2935 - A11, E3, F1
### RECYCLED MANURE: A MONEYSAVER AND ANSWER TO A PROBLEM,

W. Thompson
Progressive Farmer, Vol. 90, No. 12, p. 20-21, December, 1975. 3 fig.

Descriptors: Recycling, Cattle, Economics, Feeds, Feedlots.
Identifiers: Refeeding, Manure.

Sam B. Hay, Jr., of Covington, Georgia, has turned the cattle manure problem into a profitable venture by refeeding the manure from his concrete beef feedlot. Based on 1975 prices, the manure is worth $62 a ton when used for feed as compared to $5-$7 a ton when used as a fertilizer. Mr. Hay found that beef cattle gained as fast on feed made from recycled manure as they did on conventional hot rations, as long as manure did not exceed 40 percent of the ration. The manure was scraped from the concrete lot and augered into a chain conveyor that dropped it into an Oswalt mixer truck. Silage, haylage or hay, and rolled grain were then added. When thoroughly mixed, a blower took the feed into an oxygen-controlled, top-loading, bottom-loading, poured concrete silo. The mixture had to be stored a minimum of 10 days before using it as feed. Feeding the mixture to two different groups of steers, the average daily gain was 2.82 pounds. The net return for the steers amounted to $160 to $170 per head. Panel taste-and-tenderness tests showed no difference in the meat from these steers. (Cannon-East Central)

## 2936 - A4, F1, F2

### ECONOMIC IMPACTS OF SELECTED WATER POLLUTION CONTROL RULES ON MICHIGAN BEEF FEEDLOTS OF LESS THAN 1,000-HEAD CAPACITY,

Department of Agricultural Economics, Ohio State University
D. L. Forster, L. J. Connor, and J. B. Johnson
Michigan State University Agricultural Experiment Station Research Report 270, April, 1975, 16 p. 2 fig, 15 tab, 10 ref.

Descriptors: Economics, Michigan, Feedlots, Water pollution control, Legislation, Cattle, Agricultural runoff.

The objective of this study was to analyze the economic impacts of fed-beef producers and consumers of alternative water pollution control rules on beef feedlots of less than 1,000-head capacity. Four alternative water pollution rules with the potential for application to Michigan beef feedlots of less than 1,000-head capacity were investigated. The rules were: (1) Require beef feedlots of less than 1,000-head capacity to control runoff from a 10-year, 24-hour storm by 1977 and a 25-year, 24-hour storm by 1983. (2) Require that beef feedlots of less than 1,000-head capacity have facilities to control runoff from a 25-year 24-hour storm by 1977. (3) Require that firms of less than 1,000-head capacity have the facilities to control runoff for rainfall over a 6-month period by 1977. (4) Require that firms of less than 1,000-head capacity be prohibited from spreading solid wastes in the winter, plus have retention facilities to control runoff for rainfall over a 6-month period. Static and multiperiod models were utilized in this study. In the static analysis, additional capital requirements and changes in annual production costs attributable to compliance with alternative water pollution control rules were determined for particular capacity-type housing technology combinations. In the multiperiod analysis, a sample of Michigan feedlots with identifiable physical and financial characteristics was simulated over the 1974-1985 period to reflect the performance of Michigan feedlots through time under each of the pollution control rules. Aggregate performance in the absence of water pollution rules. Investigating the effects of the rules on the equity positions allowed an approximation of the losses that feedlot operators would suffer upon complying with these rules. (Cameron-East Central)

## 2937 - A8, B2, E2

### CHICKEN MANURE—WORTH MORE THAN EGGS?,

Progressive Farmer, Vol. 91, No. 3, p. 112, March, 1976. 1 fig.

Descriptors: Poultry, Fertilizers, Coastal bermudagrass, Crop response, Costs, Florida, Sprinkler irrigation
Identifiers: Land disposal, Chicken manure

Roger Williams, Gainesville, Florida, uses the manure from his 80,000 layers and pullets as a fertilizer. He grows Coastal bermudagrass on land that is considered to be completely unproductive. Williams has found that by putting out the chicken manure at least every 10 days, he gets a high degree of efficiency in relation to what he puts out and what he recovers in the Coastal bermudagrass. This year he plans to grow 6 tons an acre—a ton from each of 5 or 6 cuttings made 18 to 21 days apart. Williams has found that spreading liquid manure in front of a circular irrigation system is a way to prevent odor in manure spreading. He flushes the chickenhouses clean once a day and stores the liquid in a 150,000-gallon holding pit. Each week, he pumps the manure into a 5,000-gallon-capacity truck. He then spreads the manure, actually spraying out the solution up to 40 feet away just ahead of the moving sprinkler. He then reverses the sprinkler to ensure that all the manure will be washed into the soil, thus minimizing odor, flies, and loss of nitrogen. Each load takes him less than an hour. Williams says that if the price of fertilizer goes up much further, he may expand his poultry operation in order to offset the higher fertilizer prices. (Cameron-East Central)

## 2938 - A11, B1, C2, E2, F1

### FARMING BIG ON A SMALL ACREAGE,

J. Bramblett
Progressive Farmer, Vol. 91, No. 3, p. 92, March, 1976. 1 fig.

Descriptors: Fertilizers, Cattle, Poultry, Litters, Performance.
Identifiers: Land disposal.

Bob Mills of Springdale, Arkansas, has on his 100-acre farm two broilerhouses with a combined capacity of 33,000 birds. Each is emptied about 5½ times a year. He has 15 acres of grapes and 80 acres are in pasture where he runs 60 cows and heifers and cuts as much as 6,700 bales of hay per year. Chicken litter, as well as good management, has built the once poor Ozark farm into a lush, productive homestead. Mills raises chickens on contract and in a year's time will produce around 176,000 broilers. Litter is spread over pastures where it transforms thin normally unproductive soil into topnotch grassland. Fescue and orchardgrass pasture plus a small acreage of bermudagrass carry a cow and a calf per acre all year. Mills' usual application is 2 tons of litter per acre each year, plus lime as needed. A ton of litter has about 56 pounds of nitrogen, 48 pounds of phosphate, and 36 pounds of potash, plus other trace elements. Mills' best bull, so far, averaged gaining 2.88 pounds per day with a feed conversion ratio of 1 pound of gain for each 4.28 pounds of feed. Supervised by the Arkansas Cooperative Extension Service, a test indicated cost per pound of gain during the 140-day period was 27 cents. (Cameron-East Central)

## 2939 - A11, C1, C2, D2, E3, F1

### THEY FINISH CATTLE ON 80 PERCENT PLS AND 20 PERCENT CORN,

W. Upchurch
Progressive Farmer, Vol. 91, No. 3, p. 67, 70, March 1976. 2 fig.

Descriptors: Cattle, Feeds, Performance, Economics.
Identifiers: Refeeding, Finishing rations, Poultry litter, Corn.

The Acme Poultry Farms are successfully finishing beef cattle on a ration of one-third high-moisture corn and two-thirds ensiled broilerhouse litter. Eric Clark, Acme owner, figures the poultry litter, based on total digestible nutrients (TDN) and protein content, as a feed ingredient is worth about $50 to $100 a ton (about three times what it is worth as a fertilizer). Acme has three airtight Harvestore silos and two concrete feedlots. A 20- x 35-foot silo contains high-moisture corn, a 20- x 70-foot Harvestore contains haylage, and a 20- x 80-foot silo contains the chicken litter. The chicken litter is blown into the top of the largest silo and brought up to about 35 percent moisture. Although the litter is safe to use within 7 days after it goes into storage, Clark advises 30 days to make sure the feed is sweet enough for the cattle. Tests run at North Carolina State University show that the litter has about 20 percent crude protein and a TDN content of 65 percent. That is within 20 percent of the feed value of high-moisture corn. Vitamin A and Aureomycin crumbles are the only other feed ingredients the Clarks use. They use haylage as needed in the feedlots and for the gestating cows. The litter-corn ration has resulted in gains of a fraction over 2 pounds a day for steers and about 1½ pounds of heifers fed in confinement. The Clarks haven't found anything negative about this litter-feeding program except the initial investment. When looked at as a long-term investment, the concern diminishes. (Cameron-East Central)

## 2940 - A6, A7, A11, A12, B1, C2, D2, D3, F4

### HYDROGEN SULFIDE EVOLUTION FROM ANAEROBIC SWINE MANURE,

Agricultural Engineering Branch, British Columbia Department of Agriculture, Abbotsford, British Columbia, V2S 1X4, Canada
E. M. Barber and J. B. McQuitty
Hydrogen Sulfide Evolution from Anaerobic Swine Manure. Department of Agricultural Engineering, University of Alberta, October 1974, 69 p. 6 fig, 6 tab, 122 ref.

Descriptors: Hydrogen sulfide, Animal wastes, Gases
Identifiers: Anaerobic wastes, Swine, Desorption, Literature review

Hydrogen sulfide has been implicated as a principal offender in several human and animal casualties involving manure gases, and has been known to cause structural damage to metal and concrete components of livestock facilities. The major objectives of this study were (a) by means of an extensive literature review, to investigate factors affecting the production of sulfides in, and the desorption of hydrogen sulfide from anaerobically fermenting manure; and (b) on the basis of the findings, to assess potential alternate means of controlling the evolution of sulfide-containing gases from anaerobic manure. These observations and conclusions were drawn on the basis of the literature review: (1) hydrogen sulfide produced during the anaerobic fermentation of livestock manure is a major constituent of the characteristic manure odor and is known to adversely affect the health of livestock and farm operators; (2)sulfur-containing gases are produced by biological and bio-chemical transformations from sulfur compounds in manure; (3) chemical control of hydrogen sulfide seems to offer several advantages, including lower capital costs and convenient adaptability to existing waste management facilities; (4) from the standpoint of acquisition and safety in handling, iron appears to be the most suitable metal for precipitating sulfides from manure; (5) lime may exert an effect on odor released from anaerobic manure by retarding bacterial action or by minimizing the volatilization of soluble odorous constituents; (6) chemical oxidizing agents may offer an alternative to aeration as a means of controlling the oxidation-reduction potential of stored animal manure. (Cameron-East Central)

## 2941 - A8, B1, C1, D1, E2, E3, F1

### FLUSH-FLUME MANURE SYSTEM WORKING WELL,

Wallaces Farmer, Vol. 101, No. 2, p. 98-99, January 24, 1976. 3 fig.

Descriptors: Cattle, Waste disposal, Iowa, Confinement pens, Feedlots, Design, Performance, Moisture content.
Identifiers: Flush-flume manure system, Land spreading, Waste water reuse, Feed additives.

The Co-op confinement feedlot near Sioux Center, Iowa, operating over 2 years, is successfully using the flush-flume waste disposal system for heifers fed in confinement. The operators have found they get optimum results by keeping water flowing through the flumes continuously, rather than trying to flush out accumulated manure at intervals. The co-op installed a manure reclaiming unit to remove solids from the flushed water. The waste water goes through a vibrating screen to separate solids from water. Collected solids are then passed through a press to remove additional moisture. The final product is a 70 percent moisture material, something like corn silage. The collected manure is spread on cropland to reclaim its fertilizing value. Evan Vermeer, nutritionist of the feedlot's mill, reports that heifers have performed more consistently in the buildings than steers. To prevent injury problems with confined heifers, the feed additive MGA is used as a growth promotant which suppresses heat. The material's growth promoting effects probably increase gains by 10 percent—or a savings of $15 or $20 per heifer. Typical rate of gain for feedlot heifers has been about 2 to 2½ lb. per day. Steers have been going 2¼ to 3 lb. per day. The co-op soon plans to erect a fourth building of equal size, widening the gap under the eaves to provide slightly more ventilation. (Cameron-East Central)

## 2942 - B4, E2

### EARTH MANURE PIT EASES SPREADING PRESSURE ON CONFINEMENT OPERATION,

Beef, Vol. 12, No. 5, p. 6-7, 10, January, 1976. 3 fig.

Descriptors: Cattle, Waste storage, Confinement pens.
Identifiers: Slatted floors, Manure pits, Outdoor earthen manure pits, Land spreading.

Gene Haen solves the problem of a full manure pit under a slatted floor by "backstopping" his regular under-the-floor storage with two huge outdoor earthen manure pits. When an inside pit gets full, he agitates the pit and pumps the manure into one of the outside structures, where it is held until it's convenient to spread it on cropland. Haen's outdoor pits measure 110 feet by 120 feet for each pit. The units are 12 feet deep, with a one-foot slope across the bottom. The pits have concrete floors, but earth sidewalls (the heavy soil in the area guarantees no real leakage from those pits). Haen uses a lot of the manure on hayland. He feels one key to getting full value out of the manure is a continuing, complete soil analysis program. Haen reports that the big earthen pits have not created any odor problems around his operation. The Wisconsin cattleman also reports very little maintenance is necessary. For Gene Haen, outdoor manure pits have offered an ideal, economical way to expand the capacity of those under-the-floor pits. (Cameron-East Central)

## 2943 - A9, A11, A12, C2, C3, E3

### HEALTH ASPECTS OF RECYCLING ANIMAL WASTES BY FEEDING,

Department of Animal Science, Virginia Polytechnic Institute and State University, Blacksburg
J. P. Fontenot and K. E. Webb, Jr.
Journal of Animal Science, Vol. 40, No. 6, p. 1267-1277, June, 1975. 7 tab, 89 ref.

Descriptors: Public Health, Feeds, Animal wastes, Nutrients, Pathogenic bacteria, Molds, Pesticides, Heavy metals, Recycling
Identifiers: Refeeding, Animal health, Drugs

The United States produces about 1.6 billion tons of animal wastes annually. These wastes must be handled with the least risk to human and animal health. These wastes contain nutrients and can be fed to farm animals without affecting meat, milk, or eggs. F.D.A. does not sanction waste recycling because of potential dangers from pathogenic bacteria, molds, and residues of pesticides, drugs, and heavy metals. Pathogens are destroyed by heat and chemical treatment of the waste. Proper storage and handling of wastes eliminate waste molds, and pesticide residues have not been reported. Extensive research is needed concerning the effect of drugs and heavy metals on animals and withdrawal times for animals fed high levels of these should be set. No indication of harmful effects from these on humans have been reported. The only effect on animals was copper toxicity in sheep fed poultry manure containing high levels of copper. Apparently animal wastes may be safely recycled by refeeding. This would increase the food supply and decrease environmental pollution. (Cannon-East Central)

## 2944 - B1, F6

### AN HONOR FOR SUPER SLURPER,

Agricultural Research, p. 12-13, January, 1976. 3 fig.

Descriptors: Absorbtion, Gels.
Identifiers: Super slurper, Grafting.

Industrial Research magazine recently congratulated Northern Regional Research Center chemists M. Weaver, George Fanta, William Doane, and Edward Bagley for their work on super slurper. This product can absorb 1400 times its weight in distilled water, half in 30 seconds and most of it in 10 minutes. It can absorb 50 to 100 times its weight in mineral solutions such as hard water and has 20 times the urine-holding capacity of cellulose against a force 45 times gravity. It congeals water to a gel that is like soft, rubbery ice, but not cold, which can be handled more easily than a liquid. Super slurper is made by grafting. Starch from corn or other farm crops is combined with acrylonitril. This is treated with lye to produce a hydrolyzed starchpolyacrylonitrile graft copolymer. It is made in the form of flakes, film, powders, or mat. These forms swell to duplications of their own shapes but do not dissolve. In studies made by Iowa State University, oats planted in a slurper-sand mixture lived 11 days longer than oats in sand alone and had 10 times as much top growth. Super Slurper can be used in animal bedding, kitty litter, diapers, bandages, surgical pads, and dental absorbents. Samples are available at Northern Regional Research Center, Peoria, Illinois. (Cannon-East Central)

## 2945 - A8, A9, E2, F1

### THE ECONOMIC VALUE OF ORGANIC MATTER IN CROP PRODUCTION,

J. Cox
Compost Science, Vol. 16, No. 5, p. 24, Autumn, 1975.

Descriptors: Economics, Energy, Fertilizers, Pesticides, Organic wastes, Costs, Crop response.
Identifiers: Land application.

A study conducted at St. Louis's Washington University by Dr. Barry Commoner and 6 others, concludes that farmers who have built up soil humus, fertilized with green and animal manures, and practiced crop rotations achieved a net profit about equal to conventional farmers, and comparable yields, but used one-third less energy in the production. The researchers examined 16 organic farms in Iowa, Missouri, Illinois, Minnesota and Nebraska, matching each to a farm of similar size operated with conventional crop-production practices. The farms ranged in size from 175-785 acres and were selected over a wide area to include as many types of soil and terrain as possible. Principle crops produced were corn, soybeans, wheat, oats, and hay. All farms also raised hogs or cattle or had dairy herds. On the conventional farms, expenditures for fertilizers, other soil amendments and pesticides constituted about one-half of variable operating costs, amounting to an average of $23 per acre of cropland. This compares to an average of $7 per acre on the organic farms. This additional investment in increasingly-expensive production inputs generated only $14 per acre more gross income than the average for the organic farms. Organic farms are much less vulnerable to disruptive effects of growing energy shortages and price increases and profitability of organic farms is less vulnerable to the impact of declining crop prices. Additional research shows that a humusy soil protects crops from a host of soil-borne diseases. Thus the economics involved in using organic wastes on land are becoming obvious to more and more farmers. (Merryman-East Central)

## 2946 - B2, B4, D1, D2, E2

### HYDRAULIC MANURE REMOVAL FROM LIVESTOCK AND POULTRY FACILITIES,

Extension Agricultural Engineer, Washington State University, Pullman
R. E. Hermanson
Publication No. EM3797, Cooperative Extension Service, College of Agriculture, Washington State University, Pullman, September, 1973, 8 p. 4 fig.

Descriptors: Confinement pens, Livestock, Poultry, Liquid Wastes, Hydraulic systems, Lagoons, Irrigation, Waste storage.
Identifiers: High Pressure cleaning, Flush system, Oxidation ditch.

The manure handling system is often the controlling factor in successful, large, confinement livestock and poultry facilities. The system must be economically and technologically feasible without polluting the land, air, or water. In hydraulic systems, large amounts of water transport the manure. This high-volume, liquid manure is carried to a storage tank, lagoon, outside oxidation ditch, or irrigation system. Gravity-flow gutters should slope at least 2 feet per 100 feet and pipe should be at least 8 inches in diameter. The 2 basic hydraulic manure removal methods are high-pressure cleaning and the flush system. High-pressure cleaning saves time. Solid manure is softened, scrubbed and transported to a disposal system. The necessary equipment includes a high-pressure water source, hose, and nozzle. In hog and poultry facilities, cleaning is most effective when using 8-10 gallons per minute at 70-80 pounds per square inch through a 3/16 inch nozzle. A ¼ inch nozzle with a flow of about 15 gallons per minute at a pressure of 80-100 pounds is recommended for cattle manure. In flush systems, manure is moved by a fast-moving wall of water provided by a quick-opening gate in a storage tank, a dipping flush tank, or a pipe and valve system. Gutter or alley slope should be 1 foot per 100 feet. Flush tank depth is important and varies from 2.5 to 10 feet. Tipping flush tanks are usually triangular or trapezoidal cross sections with an off-center pivot point on each end of the tank. Cattle manure flushing requires about 10 gallons per foot of alley. The maximum alley length is about 200 feet. Lagoon intakes and outlets should be located 4-6 feet below the surface. Hog manure can be flushed 150 feet. Apparently, 15 gallons of water per hog per day are required. Poultry systems may also use flush systems. (Cannon-East Central)

## 2947 - B3, D2, E3, F1

### ENSILED USE OF CAGE WASTE, CHOPPED ROUGHAGE DETAILED,

Feedstuffs, Vol. 47, No. 53, p. 15, December 29, 1975

Descriptors: Poultry, Fermentation, Silage, Nitrogen, Economics
Identifiers: Ensiled cage waste, Refeeding, Roughage, Crude protein

J. W. Claybaugh of DeKalb AgResearch, Inc.'s poultry division, says that ensiled cage waste with the proper proportion of chopped roughage is a good way to utilize these two wastes. Converting cage wastes into silage eliminates the need for a manure drier and fuel to operate it. Fresh manure, which has undergone bacterial decomposition, does not smell. After ensiling, the manure contains maximum amounts of nitrogen and crude protein and it is palatable. The manure is then added to chopped roughage, which may consist of corn field residue, straw, hay, or pasture clippings. The silage thus derived is about equal to alfalfa hay and can provide a maintenance ration for pregnant dry cows, stockers, and developing heifers with only vitamins A, D, and E needed to be added. Good silage depends on proper fermentation. This depends on correct moisture, proper nutrients, and adequate packing in an oxygen-free environment. The ensiling process changes the value of cage waste from that of fertilizer at about 30-40 cents per year per bird, to 80 cents, based on crude protein value compared with $100 per ton soybean meal. (Cannon-East Central)

## 2948 - A11, B5, C2, E3

### SHOULD DPW BE USED IN POULTRY RATIONS?,

Poultry Digest, Vol. 34, No. 405, p. 438, November, 1975.

Descriptors: Feeds, Nutrients, Costs, Toxins.
Identifiers: Dried poultry wastes, Refeeding.

Points to consider before deciding to refeed dried poultry waste are: (1) Samples of DPW brought together from different sources may vary widely in composition and nutrient value. (2) Despite variability of DPW from different sources, it should be possible for an individual producer of DPW to put out a uniform product of known nutrient value if the raw material is being produced by birds under his management and the drying process is carefully controlled. (3) Crude protein values of DPW are fairly high, but much of the nitrogen is nonprotein and of limited use to nonruminant animals. (4) Because true protein values (10-11 percent) are in the same general range as the common cereal grains, DPW cannot be considered a protein supplement for poultry rations. (5) Because DPW has a low energy value, it has a distinct diluting effect on the final energy level of a ration. (6) DPW is a good source of phosphorus. (7) Most nutritionists would not recommend DPW for rations formulated to produce rapid growth (broilers, turkeys). Uric acid may be toxic to chicks and poults. (8) Experimental results suggest DPW can be used in layer rations at levels up to 10-12 percent without significant effect on production, feed efficiency or egg size. (9) Whenever DPW is used in a ration, it should not be merely as a substitute for another ingredient on a pound-for-pound basis. Actual nutrient analysis and cost should be considered in the ration formulation so that DPW competes with alternative feed ingredients. (10) Research on the use of DPW in poultry rations is still scanty. There is need for exploring the potential for including DPW in rations for replacement pullets, molting layers, and broiler breeders. (Cocon-East Central)

### 2949 - A6, A7, B1, C2, D2
### ODOR CONTROL FOR CONFINED BEEF CATTLE FEEDLOTS,

Agricultural Engineering Department, Texas Tech University, Lubbock
J. P. Ford and W. L. Ulich
Presented at the 1st Annual Symposium on Air Pollution Control in the Southwest, Texas A&M University, College Station, November 5-7, 1973, p. 189-204. 1 fig, 3 tab, 19 ref.

Descriptors: Cattle, Feedlots, Liquid wastes, Solid wastes
Identifiers: Odor control, Masking agents, Counteraction

The importance of the cattle industry to agriculture and an introduction to odor problems from confined animal feeding operations are discussed. Odor control methods considered feasible for beef cattle feeding in conventional lots are reviewed. Seven materials which were felt to have a capability of controlling or modifying the production of malodors were tested. Sulfurous compounds, amines, and possibly ammonia were shown to be important components of cattle feedlot odors. Both liquid and solid manures were found to produce the same classes of odorous gases under anaerobic conditions. Housekeeping, combined with the application of of odor control material when necessary, was judged to be capable of economical cattle feedlot odor control. Potassium permanganate and Ozeno were found to be the most economical odor control materials considered in the tests. (Ford and Ulich-Texas Tech)

### 2950 - C1, C2, D2, E3
### THE CHEMICAL CONVERSION OF BOVINE WASTES,

Department of Chemical Engineering, Texas Tech University, Lubbock
H. D. Young, J. E. Halligan, and H. W. Parker
Presented at the 1st Annual Air Pollution Control Symposium in the Southwest, Texas A&M University, College Station, Texas, November 5-7, 1973, p. 233-256. 6 fig, 3 tab, 11 ref.

Descriptors: Gases, Design, Physical properties, Chemical properties, Energy, Char.
Identifiers: Chemical conversion, Fluidized bed reactor, Anhydrous ammonia.

A small scale fluidized bed reactor was operated at elevated temperatures with manure, air, and steam as the principal feed streams. The product gases contained considerable amounts of valuable constituents such as $CO$, $CH_4$, $H_2$, $C2D_2H_4$. Calculations are presented which suggest that, using conventional technology, the product gases could be shifted and purified to ultimately lead to a gas which could be converted to anhydrous ammonia. Material and energy balances around the reactor are presented to permit projections concerning the feasibility of the overall process. (Young-Texas Tech)

### 2951 - A2, A4, A5, A8, B2, E2
### DISPOSAL OF CATTLE FEEDLOT RUNOFF ON AGRICULTURAL LAND,

Department of Agricultural Engineering, Nebraska University, Lincoln
H. D. Wittmuss
Completion Report, Water Resources Research Institute, University of Nebraska, June, 1975, 50 p. 11 fig, 26 tab.

Descriptors: Feedlots, Agricultural runoff, Waste disposal, Crop production, Pollution effluents, Sprinkler irrigation, Nutrients, Deep percolation, Absorption, Corn (field), Chemical analysis, Waste treatment.
Identifiers: Effluent irrigation.

Cattle feedlot runoff was applied to sod planted corn for three years at rates up to 30 inches per year without pollution of soil, crop, surface water or groundwater. Data were collected on many areas of crop production to check the effect of effluent irrigation compared to water irrigation on sod planted corn. All tests to date show no discernible difference in forage or grain nutrient content. The grain yield was suppressed 20 percent or more by the sprinkler application of effluent every two weeks, compared to water irrigated plots, during the growing season. Water and effluent were applied to sod planted corn in ten applications with maximum applications of 30 inches a year for three years. The application was measured and analyzed chemically for nutrients. Forage and grain yields were determined and each was analyzed chemically for nutrient composition: The percentage of crop uptake of applied nutrients was determined and ranged from 1 to over 100 percent and could be related to crop response in many cases. Percolate samples were collected from the 7-foot depth and analyzed chemically showing a slight increase in the nitrogen content below the effluent plots. The chemical composition of the soil was determined before, during and after the study. (Wittmuss-Nebraska University)

### 2952 - A2, A5, B2, C2, E2
### ANIMAL WASTE UTILIZATION FOR POLLUTION ABATEMENT TECHNOLOGY AND ECONOMICS. PHASE 2,

Department of Agricultural Engineering, Nebraska University, Lincoln
O. E. Cross
Nebraska University Water Resources Research, Lincoln, Institute Project Completion Report, February, 1974, 25 p. 15 fig, 2 tab, 6 ref.

Descriptors: Water pollution sources, Groundwater pollution, Agricultural runoff, Waste disposal, Fertilizers, Irrigation practices, Return flow, Nitrates, Sodium, Potassium
Identifiers: Land disposal

The pollution potential of the runoff from manured soil involves nitrate, sodium, and potassium. High manure applications to cultivated soils will cause limited pollution of surface runoff water and only during the first fifteen minutes of the first runoff event. The concentration of pollutants in this runoff water is below the limits set for irrigation water. Hence, all runoff should be recycled for irrigation uses: After four years of testing heavy manure application groundwater retained potable quality. Repeated annual application of heavy rates of manure on land may lead to deterioration of the physical properties of soil, owing to the large amounts of sodium and potassium in manure. In 1972 and 1973, these two elements did not continue to increase in concentration. Also, feeding excess quantities of sodium and potassium beyond the minimum requirement for the animals is being avoided. The initial intake of water into the soil increases as high manure loadings are applied. The basic intake rate is higher on areas plowed 8 inches deep. The basic intake rate on any specific manure loaded area increases with time elapsed from date of manure application. (Knapp-USGS)

### 2953 - B2, C1, C2, D3, F6
### LABORATORY SIMULATION OF SWINE MANURE LAGOONS,

Department of Agricultural Engineering, Clemson University, Clemson, South Carolina
C. L. Barth
Presented at Seventieth Annual Meeting of the Association for Southern Agricultural Workers, Incorporated, Atlanta, Georgia, February, 1973, 9 p. 6 fig, 5 tab, 11 ref.

Descriptors: Anaerobic lagoons, Design criteria, Chemical properties, Physical properties, Waste treatment, Biodegradation, Temperature, Load distribution, Southeast U.S.
Identifiers: Swine, Laboratory simulation, Detention time, Loading rates, Volatile-solids-reduction.

Anaerobic lagooning of swine manure waste is widely used and is considered successful in the southern region of the United States. Evaluation of the variations in design standards employed by individual states in the region indicates that much uncertainty exists in the application of present knowledge and design values. A progress report is presented on a study of anaerobic lagooning properties of swine waste. Findings indicate the effect of loading rate and temperature on lagoon operations. This research provides basic knowledge on lagoon operation under conditions prevalent in the southern region and contributes to more uniformly applied design criteria. (Barth-Clemson University)

### 2954 - A11, D3, E3
### BIOLOGICAL CONVERSION OF ANIMAL WASTES TO NUTRIENTS,

Department of Avian Sciences, Colorado State University, Fort Collins
B. F. Miller
Environmental Protection Agency Report No. EPA 670/2-73-09 June, 1973, 68 p. 9 fig, 30 tab 36 ref.

Descriptors: Recycling, Feeds, Proteins, Poultry, Larvae.
Identifiers: Catabolism, Feeding trials, Feed conversion, Fly egg hatchability, Musca Domestica.

As part of studies to determine how living organisms may be used to catabolize poultry manure, larvae of house flies (Musca Domestica) were used to process poultry manure, with the pupae being used as a feed supplement. Temperature and relative humidity conditions were determined to produce an optimum yield of dry pupae. Three feeding trials were conducted to evaluate fly pupae and catabolize poultry manure residue as protein sources for growing chickens. White Leghorn chicks, White Plymouth Rock chicks, and New Hampshire and Indiana River broiler chicks were fed the various diets and differences in body weight and feed conversion were reported. The results indicated that fly pupae have potential as a protein supplement in chick starter and broiler diets; the protein quality was found to be similar to that of meat and bone meal or fish meal, and superior to soybean oil meal. (Miller-Colorado State University)

### 2955 - A2, A8, B2, B4, D3, E2
### DAIRY MANURE MANAGEMENT METHODS,

Washington State University, Pullman
D. E. Proctor
Environmental Protection Agency Report No. EPA SW 530 67D, 1974, 130 p. 34 fig, 9 tab, 5 ref.

Descriptors: Dairy industry, Anaerobic lagoons, Confinement pens, Sprinkler irrigation, Agricultural runoff, Crop response
Identifiers: Waste management, Hydraulic flushing, Seasonal storage, Land application.

New pens for the confinement and feeding of dairy cattle were constructed under a continuous roof area to prevent the addition of precipitation to the cattle excrement. The manure was collected in underground sumps, pumped to large anaerobic lagoons, for wet season storage, and subsequently applied to cropland during the comparatively dryer summer months. Observations were made to evaluate, at least partially, the effect of the roofed environment upon the cattle. Some unsuccessful attempts were made to collect the excrement by hydraulic flushing techniques alone. The pump and pipeline transport of manure slurries either to storage or to large bore field irrigation nozzles was quite successful. Observations of surface pondings and runoff, soil penetration, and crop response indicated that the concept of seasonal storage and seasonally scheduled cropland disposal of dairy manure slurries can be an environmentally acceptable and agriculturally compatible method of dairy manure management. Attempts to aerobically treat manure slurry supernatant liquor were technically successful but still impractical. (Proctor-Washington State University)

## 2956 - D3, E3
### METHANE GENERATION,
Department of Agricultural Engineering, Michigan State University
J. B. Gerrish and Fred Hall
Agricultural Engineering Facts Sheet No. 25, File No. 18.1, Michigan State University, July, 1974, 2 p. 1 tab.

Descriptors: Methane, Energy, Animal wastes, Anaerobic digestion.

While methane generation from anaerobic digestion of animal wastes sounds inviting, there are many problems yet to be solved, including: (1) Methane bacteria require warm (95 degrees F) temperatures. Lowering the thermostat to 68 degrees F reduces methane production by more than half. In January, a good portion of the gas produced in Michigan would have to be sacrificed just to keep the digester warm. (2) Methane bacteria cannot tolerate a sudden slug of manure. The digester must be fed a small amount of manure daily which has been diluted 2 parts water to 1 part manure. This increases the amount of waste and aggravates the waste disposal problem. (3) Methane gas contains hydrogen sulfide which burns to sulfur dioxide, a well-known air pollutant which reacts with water to form sulfurous acid. Sulfurous acid reacts with oxygen to form sulfuric acid which can eat the insides out of engines, furnaces, and lungs. (4) Because methane gas contains a lot of carbon dioxide, there is waste space in any storage tank. To get a cruising range of 40 miles in a small methane-driven car, the tank must hold 36 cubic feet at 150 lb. pressure. Thus the tank would be as large as the car! Obtaining higher pressures would involve expensive multi-stage water-cooled explosion-proof compressors. (5) Energy storage may be an unforeseen expense. Large pressure tanks are expensive. Gas production is best in the summer when the need for heating fuels is not very great. However, the methane might be used to dry some crops. (6) Capturing methane from animal manures probably does not fit in very well with current American farming practices. Until energy shortages approach the severity of post-war Europe, methane production probably will not catch on. (Merryman-East Central)

## 2957 - A8, E2
### EFFECT OF DAIRY CATTLE MANURE ON MILLET AND RYE FORAGE AND SOIL PROPERTIES,
Department of Natural Resource and Environmental Studies, Alabama A&M University, Normal
L. M. Mugiwra
Journal of Environmental Quality, Vol. 5, No. 1, p. 60-65, January-March, 1976. 6 fig, 4 tab, 15 ref.

Descriptors: Dairy industry, Crop response, Forages, Soil properties, Nutrients, Nitrates, Alabama, Rates of application.
Identifiers: Land application, Millet, Rye, Soil depth intervals.

A study was conducted to determine maximum loading rates of dairy cattle manure as measured by forage yields, nitrate levels in plants and soils, and recovery of plant nutrients on Decatur silty clay loam under northern Alabama conditions. Dairy cattle manure was incorporated into Decatur silty clay loam plots at rates of 0, 22, 44, 89, 178, and 267 metric (dry weight) for 3 successive years. Pearl millet was grown in summer and was clipped twice and "Wrens Abruzzi" rye was grown as a winter cover crop. Manure application increased growth of and nitrate-N content in millet grown in summer, but generally no increases in forage yields were obtained with annual applications of manure higher than 44 metric tons per half acre. Although dry matter and nitrate-N content in the winter crop were not affected by manure applied in the first 2 years, rye yields accounted for 44.4, 39.8, and 44.6 percent of the total dry matter produced each season. Rye forage removed only 8 percent in each of the first 2 seasons and 12 percent in the third year of the total nitrate-N removed by both crops. The uptake of P, Ca, and Mg by plants was less affected by high manure rates than N, K, and Na uptake. Nitrate-N measured each season in the 0-90 cm depth of manured plots indicated that 58, 47, and 55 percent of the total nitrate remained within the surface 30 cm. However, annual applications of manure at 89, 178, and 267 metric tons per half acre resulted in the greatest downward movement of nitrates. Data did not indicate accumulation of nitrate-N in plants and soil with consecutive manure applications. Manure effects on the soil parameters measured were largely restricted to the top 30 cm of soil, except for exchangeable K and Na which accumulated deeper in the profile at 178 and 267 metric tons per half acre. (Merryman-East Central)

## 2958 - A8, B2, C2, E2
### EFFECT OF BEEF-FEEDLOT-LAGOON WATER ON SOIL CHEMICAL PROPERTIES AND GROWTH AND COMPOSITION OF CORN FORAGE,
Kansas State University, Manhattan
G. W. Wallingford, L. S. Murphy, W. L. Powers, and H. L. Manges
Journal of Environmental Quality, Vol. 3, No. 1, p. 74-78, 1974. 6 fig, 3 tab, 6 ref.

Descriptors: Feedlots, Lagoons, Soil properties, Crop response, Irrigation, Salinity, Cattle, Nutrients, Rates of application.
Identifiers: Land application.

A study was conducted to determine growth and composition of corn (Zea mays L) forage and chemical properties of a Kansas soil as affected by furrow irrigation with beef-feedlot lagoon water. The study site was located 9.6 km north of Pratt, Kansas, on a silty clay loam soil with a cation exchange capacity of 19 meg/100g and a pH of 7.0 Rates of 0, 8, 15, 26, and 46 cm per year of lagoon water from a nearby feedlot were applied during the summers of 1970 and 1971 by furrow irrigation. Corn forage yields were recorded and plant content of N, P, K, Ca, Mg, and Na were measured. Surface soil samples and soil cores were taken from the plots after harvest each year. It was found that continued applications of feedlot-lagoon water significantly increased salt content of soil. Increases in electrical conductivity of the soil were linearly related to the amount of lagoon water applied. The heaviest lagoon-water treatments contributed more salts than could be utilized by corn plants or leached into the lower portions of the soil profile. The resultant accumulations could have produced higher osmotic pressures in the soil solution. Nitrate-N accumulated in the soil from the 26 and 46 cm/year lagoon water application reflecting the relatively high N content of lagoon water. Phosphorus also accumulated with lagoon water applications but accumulations were restricted to the surface 20 cm, reflecting lack of movement of P in the soil. Yields of corn forage were maximized at accumulative application rates of about 25 cm of lagoon water over 2 years. At higher rates, yields declined. Maximum removal rates of applied nutrients, an important consideration in maintaining viability of soil, were achieved at the same application rates that produced maximum yields. (Merryman-East Central)

## 2959 - A4, A8, F1, F2, F3
### OUR LAND AND WATER RESOURCES: CURRENT AND PROSPECTIVE SUPPLIES AND USES,
U. S. Department of Agriculture. Economic Research Service.
Miscellaneous Publication No. 1290, U. S. Department of Agriculture, Economic Research Service, May, 1974, 54 p. 18 fig. 34 tab. 26 ref.

Descriptors: Land, Water, Land use, Natural resources, Conservation, Legal aspects, Economics.
Identifiers: Cropland, Land ownership, Government programs, Projections, Energy supplies, Forest land, Timber.

U.S. land and water resources are analyzed as a basis for projecting national agricultural cropland and other land needs to the year 2000. Impact of changes in technology and resource development as well as environmental and institutional factors affecting the availability of these natural resources are discussed. Emphasis is placed on the continuing responsibility of Federal, State, and local governments to assess the adequacy of our natural resources to meet future needs and to improve the quality of the environment. (U.S.D.A.)

## 2960 - A4, B1, F2
### PERMIT AND POINT SOURCE PONDERABLES,
Calf News, Vol. 13, No. 10, p. 38, 50, October, 1975

Descriptors: Permits, Feedlots, Legal aspects, Water pollution
Identifiers: Point sources, Environmental Protection Agency, ANCA, Hearings

On September 11, 1975, a hearing was held following the issuance of a Federal Court order requiring EPA to move quickly into an expansion of its discharge permit program for feedlot point sources. ANCA, present at that hearing, recommended that the following additions be made to the current Federal Register definitions of a feedlot. A. Open Lots—(1) The space allotted per animal is equal to or less than four square feet per pound of finished live weight, (2) The period of animal occupancy is 45 days or more per year, and (3) The distance to a receiving stream is less than two feet per 100 pounds of finished live animal weight. B. Housed Lots—(1) Period of animal occupancy is 45 days or more per year, (2) The processed generated waste water exceeds 20 cubic feet per day. Dr. Bart Condon, President of ANCA, stated at the hearing that direct disposal of runoff by switchback waterways and terrace systems provides lower costs as well as best possible technology. He strongly recommended the land application of manure, listing the advantages of this system and suggesting that plant-soil life (serving as a terminal receiver for manure) be classified as a non-point pollution source. It was concluded that the state-operated permit issuing system was the optimum approach. (Cannon-East Central)

## 2961 - A11, C2, E3, F1
### VALUE OF POULTRY MANURE IS INCREASING,
Anonymous
Feedstuffs, Vol. 47, No. 33, p. 6, 50, August 18, 1975.

Descriptors: Poultry, Recycling, Economics, Chemical Properties, Fertilizers, Litters.
Identifiers: Refeeding.

Three speakers at a turkey management seminar reported on research concerning reuse of poultry wastes. Dr. Hileman of the University of Arkansas stated that there has been little research dealing specifically with chemical analysis and soil application of turkey wastes. He stated that University of Georgia research showed turkeys to produce 2 pounds of manure for each pound of feed consumed consisting of 70-80 percent moisture and 20-30 percent solids. Average composition of the wet manure was 75 percent moisture, 1.4 percent nitrogen, 0.85 percent phosphorus and 0.7 percent potassium, wet basis. North Carolina research showed average composition of turkey manure with litter to be 74 percent moisture, 1.30 percent N, 0.70 percent P, and 0.50 percent K, or 1.61 percent $P_2O_5$ and 0.60 percent $K_2O$. Hileman reported, based on current fertilizer prices, that average value of a ton of turkey litter is $38.96 and average value of a ton of liquid manure is $9.49. Hileman described alternative methods for using turkey manure as fertilizer or soil amendment. Dr. T. Lionel Barton pointed out in his speech that slightly more than 50 percent of the N content of poultry waste is non-protein nitrogen and that its greatest recycling potential is in refeeding to beef cattle. Its chief limitation as a feed is its low energy content. Barton stated that ensiling appears to be the best approach to recycling poultry litter as feed. Dr. M. L. Hay described work in Arkansas in which broiler litter was fed to weaned steers and fattening steers during the winter and in which the litter was used as a supplement in wintering beef cows and calves. He felt that this was the most promising use of poultry litter. (Merryman-East Central)

### 2962 - A8, B3, C2, E2

### ACCUMULATIVE EFFECTS OF MANURE AND N ON CONTINUOUS CORN AND CLAY SOIL. II. CHEMICAL CHANGES IN SOIL,

Department of Plant and Soil Science, Vermont University, Burlington
J. L. McIntosh and K. E. Varney
Agronomy Journal, Vol. 65, No. 4, p. 629-632, July-August, 1973. 6 fig, 2 tab, 13 ref.

Descriptors: Soils, Chemical properties, Organic matter, Fertilizers, Nitrogen, Crop response.
Identifiers: Land application, Soil amendments, Manure.

Plots were established in West Addison, Vermont, in 1965 to evaluate the effects of treatments of manure and nitrogen on a Panton clay soil and on corn yield and nutrient uptake. Changes in chemical content of the soil as a result of the treatments are presented. Results concerning corn yield and nutrient uptake were presented in a previous paper. Four rates of manure (0, 22, 44, and 66 tons per ha) and five rates of N (0, 56, 112, 168, and 224 kg per ha) were combined in a factorial arrangement and applied each year to the same plots. Also 120 kg per ha of P and 90 kg per ha of K were applied for 4 years to all plots. Maintenance of structure and fertility had been difficult in this soil. It had not been intensively cultivated even though it lay in large, level fields. Annual applications of about 44 tons per ha of fresh manure were needed to maintain soil organic matter. Percentage of application did not significantly increase rate of breakdown of soil organic matter nor decrease pH. A higher proportion of P originating from manure than from inorganic fertilizer was extracted by soil test for available P (pH 4.8 $NH_4OAc$. Availability and fixation of K were not affected by source of K nor presence of manure. Moderate applications of manure (up to 44 tons per ha) did not maintain initial levels of soil Ca and Mg. At least 10 times more Ca was lost by leaching than by plant uptake. Similar calculations show 3 times more Mg was lost by plant uptake than by leaching. Test data show the value of fresh manure as a soil amendment in addition to its nutrient content. (Merryman-East Central)

### 2963 - A11, E3, F1, F2

### DPW CUTS RUMINANT FEED AND VET COSTS IN DENMARK,

Poultry Digest, Vol. 35, No. 408, p. 74, February, 1976.

Descriptors: Feeds, Performance, Cattle, Costs, Legal aspects.
Identifiers: Refeeding, Denmark.

Denmark has recently allowed marketing of dried poultry waste (DPW) for a period of two years. A successful concentrate mixture contains 40 percent poultry waste which provides 66 percent of the protein intake. Young stock have also been fed successfully on a concentrate containing 50 percent DPW and steers have been fed on a fattening mixture containing 40 percent DPW. Commonly, the waste is mixed with molasses and fat and then pelleted, which gives it a pleasant appearance and texture and a pleasant odor. One interesting claim after 3 years' use of the DPW concentrate mixture was that veterinary bills were reduced 50 percent. Savings in feed costs were estimated at $119 per cow per year. (Merryman-East Central)

### 2964 - B1, B4, F1

### CHEAPER WAY TO BUILD MANURE PITS,

Wallaces Farmer, Vol. 101, No. 3, p. 83, February 14, 1976.

Descriptors: Waste storage, Economics, Construction costs.
Identifiers: Manure pits.

The "trench and fill" method for constructing concrete liquid manure pits has been found to cut building costs and get the job done easier and faster. The method works like this. Narrow trenches are dug where the walls will be. The trenches are then filled with concrete, with soil acting as forms for the walls. After the concrete has cured, soil inside the walls is dug out with a backhoe. Then a concrete floor is poured to complete the pit. Agricultural engineers headed by E. C. Miller conducted a study concerning the costs, strength, and practicability for building liquid manure tanks with the trench and fill system. Principles of construction and cautions to be observed are outlined. Soil should be tested to learn more about possible ground water and bearing quality of the soils. The site must be leveled in order to operate effectively with a trencher. The building must be carefully measured and laid out. Pit walls must be reinforced. Six inches of gravel should be tamped into the bottom of the trench in order to reduce time needed to clean up dirt and clay. The operation should be organized so that the trench can be filled in a minimum of time (to guard against the soil collapsing). The trench walls should be lined with polyethylene sheets, which keeps the gravel and dirt out of concrete as it is poured. Final cost of the entire pit project conducted under Miller was $7016. This represented a cost of 5.5 cents per gallon of storage the pit provided. (Merryman-East Central)

### 2965 - A4, A5, A8, B2, B3, D3, E2, F1

### WATER POLLUTION FROM AGRICULTURE,

Kungliga Lantbrukshogskolan, Uppsala, Sweden.
N. Brink
Journal Water Pollution Control Federation, Vol. 47, No. 4, p. 789-796, April, 1975. 3 fig, 9 tab, 1 ref.

Descriptors: Agricultural runoff, Water pollution, Fertilizers, Farm wastes, Groundwater, Urine, Livestock, Nitrogen, Phosphorus, Nitrates, Nutrients, Water pollution sources, Europe, Feeds, Feedlots, Sludge, Silage.
Identifiers: Sweden.

Risks of surface and groundwater pollution in Sweden are increasing due to increased livestock production and use of commercial fertilizers in agriculture. Urine and silage juice are especially rich in organic contaminants. Wastewater from dwellings is usually treated in septic tanks before release into open water or infiltration into the ground. To prevent water pollution, manure and silage juice should be spread on arable land. The application of sewage sludge as a fertilizer should not exceed 150 tons per half acre in wet form and be spread at widely spaced intervals. Urine, dungyard water, liquid manure, and silage juice may leak into surface and groundwater from animal stables. Commercial fertilizer use has increased, thus climatic and soil factors are crop growth limiting. Nitrogen is mostly in the form of nitrates, with very small amounts of ammonia. Phosphorus is sometimes very high in groundwater. Chemical reduction probably plays a role in deeper layers, especially in clay soils. The nitrogen budget for a field at Nasbygard, Sweden is given; most of the input went to grain, some to air and water. Neither burning of straw nor excessive fertilizer is acceptable husbandry. (Buchanan-Davidson—Wisconsin)

### 2966 - B1, E2

### EQUIPMENT FOR INCORPORATING SEWAGE SLUDGE AND ANIMAL MANURES INTO THE SOIL,

Department of Biological and Agricultural Engineering, Rutgers — The State University, New Brunswick, New Jersey
H. Reed
Presented at Proceedings of Conference on Land Disposal of Municipal Effluents and Sludges, Rutgers University, New Brunswick, New Jersey, March 12-13, 1973, p. 91-100a.

Descriptors: Equipment, Sewage sludge, Sludge disposal, Farm wastes, Soil disposal fields, Application equipment
Identifiers: Land application

The incorporation of wastes directly into the soil is superior to surface spreading because there is no odor, no opportunity for flies or other pests to feed or breed, and no runoff or surface erosion of wastes. Also, the wastes are placed in the best possible media for immediate degradation to plant nutrients and utilization by plants. The design of an effective land treatment system and the selection of appropriate equipment necessitates the consideration of many factors, some of which are outlined. Presented are equipment and devices used for such application techniques as the ridge-and-furrow method, sub-sod-injection, and plow-furrow-cover. (Sandoski-FIRL)

### 2967 - A11, B3, C1, C2, C3, D2, E3

### LITTER AS A FEED FOR BEEF ANIMALS,

Texas A&M University, College Station
C. R. Creger
Poultry Digest, Vol. 35, No. 409, p. 116-117, March, 1976. 6 tab.

Descriptors: Litters, Feeds, Performance, Cattle, Fermentation, Silage, Moisture content.
Identifiers: Refeeding, Ensiling, Poultry litter.

At a Texas A&M University laboratory, poultry manure was fed to beef cattle. The broiler litter was fermented in an upright silo at a moisture content of 35 to 40 percent for a 6 to 8 week period. The protein content varied not only with the number of groups of birds reared on the litter, but also with the type of feed management that takes place in the house. Broiler litter silage was fed *ad libitum* to 15 heifer calves weighing an average of 477 pounds each. Eight pounds per head of a 12 percent protein mixture, consisting of ground milo, dehydrated alfalfa meal, soybean meal, molasses and vitamin A and D, was poured over the silage daily. An average of 12 pounds of silage per head, per day was consumed. After 120 days of feeding, the calves gained 2.54 pounds per head, per day when fed the broiler litter silage *ad libitum* along with 12 percent protein mix. Feed was also formulated from chicken and turkey droppings without going through the fermentation process. This increased the chance of salmonella contamination of the feed. The dried poultry waste was found to be an acceptable ration when mixed with one half corn or sorghum grain and 200 pounds of molasses per ton. In a field study, 350 head of feeder calves gained 2.63 pounds per head, per day and consumed an average of 10.8 pounds of a 60:40 mix of litter: milo ration over a 120-day period. (Cameron-East Central)

### 2968 - A1, B2, C2, C3, D3, E2, F6

### SWINE WASTE CHARACTERIZATION AND EVALUATION OF ANIMAL WASTE TREATMENT ALTERNATIVES,

Department of Biological and Agricultural Engineering, North Carolina State University, Raleigh
F. J. Humenik
Report No. 61, Water Resources Research Institute, North Carolina State University, Raleigh, June, 1972, 152 p. 19 fig, 41 tab, 48 ref.

Descriptors: Swine, Land disposal, Lysimeter studies, Chlorotetracycline

A study was made to evaluate analytical techniques for the characterization of swine wastes and to study methods for the treatment and disposal of animal wastes. Laboratory work provided for the analytical evaluation of the following swine waste treatment alternatives: a single unaerated lagoon, two unaerated lagoons in series, and packed soil lysimeters for land application of lagoon effluent. Work was also initiated on the application of liquid dairy manure to lysimeters. The concentrations of feed additive chlorotetracycline, copper, and zinc in swine feces, lagoon influent, lagoon effluent and BOD bioassay solutions were determined. Analyses of the experimental data for the BOD bioassay showed that results depend upon sample history, type and amount of seed organisms, incubation conditions and sample size. It was found that the unaerated series lagoon system for swine waste provides greater reduction in pollutional potential than just the original single unaerated lagoon. Data correlations and characterization values for the Precision Scientific instrumental chemical oxygen demand analyzer and Beckman organic carbon analyzer were developed for animal waste. Recommendations were presented for obtaining accurate and consistent characterization data for animal waste and suggestions were made for obtaining the most reliable BOD5 results, particularly for swine waste. (Cameron-East Central)

## 2969 - A2, A3, B1, E1

### AGRICULTURE'S PLACE IN THE ENVIRONMENT: CONSIDERATIONS FOR DECISION MAKING,

Senior Specialist, Agricultural Chemicals, Office of Agriculture, Technical Assistance Bureau, Agency for International Development, Washington, D. C.
W. H. Garman
Journal of Environmental Quality, Vol. 2, No. 3, p. 327-333, 1973. 22 ref.

Descriptors: Rainfall, Runoff, Nitrogen, Eutrophication, Water quality, Nutrients, Phosphorus, Carbon.
Identifiers: Livestock wastes, Nutrient cycling.

In terms of land area and value of natural resources, agriculture and forestry constitute the largest environmental complex on earth. The major problems are sediment and dust and organic wastes from livestock and the food and forestry processing industries. Near livestock feedlots, cities, and certain types of industrial plants, large amounts of N in such forms as nitrogen oxides and ammonia occur in the rain. Many people believe that the only solution to the 2 billion metric tons of livestock manure is to spread more and more of it on rural lands. This will cause a shift from huge feeding operations to smaller ones with lower-density stocking. This shift will facilitate control of waste runoff as well as getting manure spread on the surrounding land. The cost will be high because the value of the nutrients will not pay for the equipment and labor required. Hopefully, new on-farm technology will provide means of handling livestock wastes to protect both streams and underground waters. Small amounts of nutrients are lost to surface or underground water when farmland is maintained in a high state of fertility. Many towns, cities, and factories have added waste treatment before dumping effluents into streams. This has greatly reduced the biological oxygen demand (BOD) on the stream. (Cameron-East Central)

## 2970 - B1, D3, E3, F6

### TWO-PHASE ANAEROBIC DIGESTION OF POULTRY WASTE,

Agricultural Engineering Department, University of Georgia, Athens
R. E. Smith, M. J. Reed and J. T. Kiker
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4544, 23 p. 4 fig, 3 tab, 17 ref.

Descriptors: Design, Animal wastes, Anaerobic digestion, Poultry, Methane, Recycling.
Identifiers: Volatile acid, Digesters, Kinetic reaction.

Research was carried out at the University of Georgia to design and construct an anaerobic filter to demonstrate and obtain operating experience in the production of methane gas from animal waste. Tests were conducted with practical arrangements to produce a volatile acids substrate from poultry waste for use with the anaerobic filter. The objective was to produce a substrate relatively free of suspended solids and with a high concentration of volatile acids. It was noted during the preliminary operation of the methane digester that during a period of steady-state there was an apparent mass balance between the total gas production and the mass decrease in volatile acids from the influent and effluent concentrations and the mass flow rate of wastewater. Steady-state operation was effectively obtained after 2-3 days of operation under a set of conditions. The greatest time lag for a parameter to reach a steady value was in the effluent concentration. Research results appear to support the statement that the specific growth rate, $O_c^{-1}$, is related only to the hydraulic control of the reactor. It was observed that in the volatile acids digesters the concentration build-up of ammonia usually was about numerically equal to the volatile acids concentration. Values of pH for the effluent of the digester during the period was most often in the range of 6.5 to 7.5 (Cameron-East Central)

## 2971 - A5, D3, E1, E2,

### DISPOSAL OF CATTLE FEEDLOT WASTE IN AN ANAEROBIC LAGOON ON THE ORGANIC SOILS OF SOUTH FLORIDA--PRELIMINARY RESULTS,

Assistant Animal Nutritionist Agricultural Research and Education Center Belle Glade, Florida
F.M. Pate, B. G. Volk, T. W. Casselman, and J. R. Crockett
Proceedings, Soil and Crop Science Society of Florida, Vol. 33, p. 224-227, 1974. 4 fig, 2 tab, 15 ref.

Descriptors: Groundwater pollution, Feedlots, Florida, Lagoons, Waste disposal, Chemical properties

A study was conducted to determine the effectiveness of an anaerobic lagoon for holding beef feedlot wastes on the organic soils of south Florida. A series of tests wells were drilled 7.6, 30.5, and 61.0 m from the lagoon to monitor changes in groundwater quality. $NH_3$-N, $NO_3$-N, dissolved $PO_4$-P, chemical oxygen demand, and K were 2.0, 0.02, 0.04, 225, and 15 mg/liter, respectively. The highest levels of $NH_3$-N, $NO_3$-N, dissolved $PO_4$-P, chemical oxygen demand and K observed in lagon water were 125, 0.7, 36, 4000, and 280 mg/liter, respectively. These levels occured when manure disposal was stopped, 5 months after disposal began. The chemicals monitored rapidly diminished after manure disposal into the lagoon stopped. The only observed increase in groundwater of these chemicals was in one of 6 wells 7.6 from the lagoon. From these results, it was deducted that a moderate sized waste disposal lagoon on the organic soil region of south Florida will not immediately contaminate the surrounding groundwater, even though there was active water movement to and from the lagoon. (Merryman-East Central)

## 2972 - D2, E3, F3, F6

### AN EXPERIMENTAL STUDY ON THE PRODUCTION OF SUBSTITUTE NATURAL GAS BY HYDROGASIFICATION OF LIVESTOCK MANURE,

J. Martinez and A. Carlos
PhD Dissertation, Department of Chemical and Petroleum Engineering, University of Kansas, 1973, 113 p. 18 fig, 27 tab, 29 ref.

Descriptors: Recycling, Gases, Moisture contents, Temperature, Cattle.
Identifiers: Hydrogasification, Livestock wastes.

An experimental program was conducted in a batch reactor to determine the effects of process parameters on the yield of products when cow manure is hydrogasified. The assumption was made that the most valuable product would be the mixture of combustible gases resulting from hydrogasification of the carbon in the manure. Experiments were conducted for various (1) moisture contents, (2) initial amounts of hydrogen charged to the reactor, and (3) final maximum reactor temperatures. The general performance of the hydrogasification unit was highly satisfactory during the development of the experimental procedure. The best run yielded a product gas with a calculated heating value of 3722 net Btu/lb dry manure. This experiment was conducted with a 50 percent manure moisture content and 50 psig of hydrogen charged per 25 g. of dry manure. The analysis (on dry basis) of a gas sample taken two hours after reaching 1050 degrees F was: 14.6 percent $CH_4$, 11.5 percent $C_2H_6$, and 34.5 percent $CO_2$. For this run, 51 percent of the carbon in the manure was gasified to hydrocarbons and carbon dioxide, or 32 percent gasified to hydrocarbons. The heating unit was designed for a maximum temperature of 1350 degrees F but only temperatures of about 1280 degrees F were obtained. The maximum temperature reached in the reactor under these circumstances was between 1050 and 1080 degrees F. Further research is needed to determine fully the economic feasibility of the process when applied to this feedstock. (Cameron-East Central)

## 2973 - A3, A4, A5, A8, B5, C2, C3, E2

### CHEMICAL AND MICROBIOLOGICAL CHANGE IN POULTRY LITTER APPLIED TO SOIL AS INFLUENCED BY THE TIME AND METHOD OF APPLICATION,

A. M. Rao
PhD Dissertation, University of Georgia, 1973, 90 p. 22 fig, 12 tab, 75 ref.

Descriptors: Poultry, Litter, Chemical properties, Microorganisms, Waste disposal, Application rates, Soils, Ammonia, Coliforms.
Identifiers: Land application, Application method, Decomposition.

An investigation was conducted to determine the number and types of microorganisms during decomposition of poultry litter in soil and the effect of interval and method of poultry litter application on some soil properties with particular emphasis on possible contribution to surface and underground water pollution. The persistence and effect of ammonia concentration on coliform bacteria were also studied. These experiments were conducted both in the laboratory and in the field over a two-year-period. Laboratory studies were conducted mainly to obtain initial information for the field experiment. Separate experiments were conducted to determine (a) the effect of drying on N loss in fresh droppings, (b) the effect of rate, method and time of application of litter on nitrification, and (c) the changes in the microbial ecology of decomposing poultry droppings and litter upon incubation with and without soil. The field experiment was initiated to determine the effect of method and time of application of poultry manure on (a) soil $NO_3$-N and other nutrients' vertical distribution in the soil profile, and (b) the number and relative abundance of major groups of soil microflora including coliform bacteria. Specific results obtained in these experiments are given for both the laboratory and field studies. It was felt that the combination of an N responding crop with litter application might provide a safer and more efficient disposal method than trying to reduce nitrates by frequent applications. The abundance and movement of soil microflora was increased by litter application, but coliforms were not greatly increased. Pollution of streams by pathogens from poultry manure would more likely occur from surface runoff than from groundwater. (Cameron-East Central)

## 2974 - A11, D1, D2, D3, E3, F1, F2

### REFEEDING ANIMAL WASTE,

Beef editor
B. Eftink
Successful Farming, Vol. 74, No. 5, p. 26-27, March 1976. 5 fig.

Descriptors: Dairy industry, Feeds, Silage, Legal aspects, Economics

Identifiers: Refeeding, Ensiling, Grazon process

Although other segments of the animal industry are experimenting with refeeding waste, the beef feeding industry has confirmed that cattle actually do better on rations containing manure. Cattle have three advantages over other animals. They can use all three forms of nitrogen, they can extract energy from fibrous materials and their system acts as a filter for undesirable contaminants. W. B. Anthony of Auburn University says there are two approaches to refeeding—separate the waste into its liquid and dry component parts or handle it as it is. He feels that for small operators, using fresh manure as part of a silage mix is the most practical. Sam Hay, of Covington, Georgia mixes 40 lbs. of manure with 45 lbs. of cracked shelled corn and 15 lbs. of silage to form a 12 percent protein ration. Gains are better than on standard feed, and this way manure is worth $62 a ton when corn is selling for $3.50 a bushel. At Illinois, researchers have skipped the ensiling process by spraying a chemical on the raw manure to deodorize and kill pathogens, then mixing 50 percent manure, 25 percent corn, and 25 percent cottonseed hull. Although the FDA remains mute, Dave Seckler states that manure is valuable as fertilizer but more valuable as feed and fuel. (Cameron-East Central)

### 2975 - A6, A7, A11, D2
### AMMONIA ELIMINATED WHILE DROPPINGS ARE DRIER,
Poultry Digest, Vol. 35, No. 408, p. 66, February, 1976.

Descriptors: Waste treatment, Ammonia, Poultry.
Identifiers: Animal health, Superphosphate, Drying effect.

Hy Cross Chick Company applied superphosphate to the droppings in the earth bottom pits of brooder grow cages and in cage laying houses in order to prevent possible eye burn in the chicks. When superphosphate became unavailable and too expensive, a new odor control product, consisting of a soluble extract of seaweed dissolved in natural steroid saponins, was used in the place of the superphosphate. This new product was applied in liquid form every three days. Ammonia was completely eliminated in less than 12 hours, and a terrific drying effect on the manure was noticed in the same length of time. (Cameron-East Central)

### 2976 - A7, A11, B1, B5, C2
### GAS TOXICOSIS: SUDDEN DEATH IN CONFINEMENT,
Successful Farming, Vol. 74, No. 5, p. H33, March, 1976.

Descriptors: Confinement pens, Air pollution, Carbon dioxide, Ammonia, Hydrogen sulfide, Methane, Toxicity.
Identifiers: Swine, Gas toxicosis.

Gas toxicosis may be a cause for sudden death of hogs in confinement. Signs of gas toxicosis are muscular spasms, breathing difficulty, and then unconsciousness. Ventilation should be increased immediately upon first notice of these signs. There are four major gases released from anaerobic swine manure pits, all of which can kill—carbon dioxide, ammonia, hydrogen sulfide and methane. Carbon dioxide must be present in extremely high atmospheric levels before adversely affecting the swine. According to Iowa State University Extension veterinarian Jim McKean, ammonia levels in confinement are often the cause of gas toxicosis. Ammonia irritates the mucous membranes of the pig, and prolonged exposure may irritate the respiratory passages, leading to tracheitis or bronchopneumonia. Hydrogen sulfide is the most harmful toxic gas released from anaerobic pits. This gas is most prominent when the pits are emptied or contents are agitated. Methane is explosive in high concentration and affects swine by reducing the available oxygen in the building. To prevent gas toxicosis, confinement buildings need a minimum ventilation rate of 20 cu. ft. of fresh air per minute per sow and litter. During winter months, miminum ventilation rates are 15, 25, and 36 cu. ft. of air per minute for hogs weighing 50, 125 and 200 lbs. respectively. (Cameron-East Central)

### 2977 - A5, A8, C2, E2
### MANURE AND THE NITRATE PROBLEM,
Delaware University, Newark 19711
W. C. Liebhardt
Lime and Fertilizer Conference, Delaware-Maryland Plant Food Association Proceedings, 1972, 2 p. 2 tab.

Descriptors: Recycling, Crop response, Poultry, Nitrates, Groundwater pollution.
Identifiers: Land disposal, Application rates.

In Delaware there are approximately 140 million chickens grown each year. The amount of waste these chickens produce is greater than the amount of solid waste produced by New York City. The waste is being recycled back to the soil at so great a rate that it is reducing the crop yield. Another problem is that with the sandy soil and high water table, nitrates may leach into the ground water supply. Public health standards set the limit for $NO_3$-N at 10 ppm. In soil samples taken at a depth of 4 ft, the level found in the ground water usually exceeded this amount. Poultry manure is being added to the soil at rates of 10 to 100 tons per acre. Ten tons of manure contains approximately 254 pounds of N, 108 pounds of $P_2O_5$ and 185 pounds of $K_2O$ plus secondary and micronutrients. The corn yield at this rate is about 55.6 bushels per acre. At 100 tons of manure per acre, the yield was about 14 bushels per acre, a substantial reduction. (Cannon-East Central)

### 2978 - C1, C3, D1, D3, E3, F5
### AN EVALUATION OF A RECYCLING WASTE TREATMENT SYSTEM FOR DAIRY CATTLE MANURE,
J. C. Nye
PhD Dissertation, Purdue University, 1971, 120 p. 9 fig, 38 tab, 68 ref.

Descriptors: Recycling, Proteins, Microorganisms, Feeds, Proteins, Physical properties, Separation techniques.
Identifiers: Substrate, Dairy manure.

This study evaluated the feasibility of growing micro-organisms on manure as a source of protein for animal feed. The study was conducted as a four phase investigation including: (1) evaluation of a particle size separation of dairy cattle manure (the objective was to determine the optimum particle size limit and dilution level for separation of usable feed and feed residue from the dairy cattle manure), (2) batch culture of micro-organisms (the objective was to determine the time of maximum microbial population for a mixed culture of micro-organisms), (3) continuous cultures of micro-organisms (the objective was to investigate the conditions associated with the highest quality microbial protein supplement), and (4) evaluation of the centrifugally harvested micro-organisms as a high protein feed supplement (the objective was to determine the chemical and biological value of the microbial product as a protein supplement). Conclusions of the study were: (1) Separation of dairy cattle feces through a 595 micron opening removes a low quality roughage material from the remaining liquid waste, (2) The liquid waste removed by such a separation is a suitable substrate for the growth of bacteria, (3) The bacteria grown are a satisfactory protein supplement containing 30 percent crude protein, (4) The microbial protein product is an adequate feed supplement as 20 percent of the ration, and (5) The waste treatment-food synthesis system proposed is an economically feasible alternative for livestock operations. (Cameron-East Central)

### 2979 - A3, B2, B3, C2, D3, E2, F1
### HOW TO SAVE SWINE WASTE VALUE,
Successful Farming, Vol. 74, No. 5, p. 46, March, 1976.

Descriptors: Farm wastes, Fertilizers, Nitrogen, Phosphorus, Potassium, Economics
Identifiers: Swine, Land disposal

Nearly 70 percent of the nitrogen and phosphorus and almost 90 percent of the potassium in swine rations are excreted in waste and urine and can be recycled again for fertilizer. How these waste resources are handled makes a big difference in their value. Seventy percent of nitrogen, phosphate, and potash are excreted in the form of solid wastes. Urine contains the other 30 percent of the nitrogen, 20 percent of the phosphorus and 55 percent of the potassium. Bedded systems and deep anaerobic pit systems best conserve nitrogen. Much nitrogen may be lost from manure if it is subjected to warm, dry conditions before being disked or plowed under. Nitrogen losses may also result if runoff or snow melt occurs prior to incorporating the manure into the soil. Most systems conserve phosphorus and potassium quite well with two exceptions: (1) where runoff from outside lots is significant; (2) where prolonged use of lagoon allows a sludge buildup in the bottom of the lagoon. Unless this sludge can be reconstituted, the elements will be lost. (Cameron-East Central)

### 2980 - A3, A4, A8, A9, E1, F4
### AGRICULTURE AND CLEAN WATER—PROCEEDINGS OF A CONFERENCE TO EXPLORE CONTROL STRATEGY FOR AGRICULTURAL NONPOINT SOURCE WATER POLLUTION,
Midwest Research Institute, Kansas City, Missouri
C. C. Chappelow
Agriculture and Clean Water—Proceedings of a Conference to Explore Control Strategy for Agricultural Nonpoint Source Water Pollution, Kansas City, Missouri, April 3, 1975, 153 p.

Descriptors: Water pollution control, Water quality, Legal aspects, Farm wastes, Sediment control, Soil conservation.
Identifiers: Nonpoint source pollution, Plant nutrients, Control planning.

A 1-day conference was held to promote a constructive dialogue on the development of plans for the control of agriculture related nonpoint source pollution arising from sediment erosion, fertilizer runoff, livestock wastes and pesticide residues. The morning session was devoted to an analysis of the state of the art on nonpoint source pollution related to agriculture with presentations on: (1) regional aspects and viewpoints; (2) agricultural pollution control; (3) technical basis of control; (4) conservation districts; (5) soil conservation; and (6) plant nutrients. The luncheon session was concerned with an economic overview, consisting of an address on economic problems and opportunities of pollution control. The afternoon session was designed to explore elements of control strategy planning for nonpoint pollution from agricultural sources with papers on: (1) the state's role; (2) one state's approach; and (3) the role of the farmer and agribusiness. The afternoon session was concluded with a panel discussion on the development of a practicable agricultural pollution control plan. Over 175 individuals from 20 different states representing local, state, regional, and federal agricultural and environmental agencies attended the conference. Also, included in the 75 different organizations represented at the conference were attendees from farmer associations, educational institutions, and agribusiness.

### 2981 - A3, A4, F2, F3
### AGRICULTURAL SEDIMENT CONTROL FOR WATER QUALITY PROTECTION,
Chief, Special Sources Control Branch, Office of Air and Water Programs, Environmental Protection Agency
W. C. Shilling
Agriculture and Clean Water—Proceedings of a Conference to Explore Control Strategy for Agricultural Nonpoint Source Water Pollution, Kansas City, Missouri, April 3, 1975, p. 19-26.

Descriptors: Sediments, Agriculture, Water quality, Soil conservation, Animal wastes, Control
Identifiers: Public Law 92-500

William C. Shilling briefly discussed three major areas of agricultural sediment control. They are the (1) impact of agricultural sediments on water quality and the control of these sediments, (2) nonpoint control features of Public Law 92-500, and (3) state and local control programs. The impact of agricultural sediments on water quality generally falls into three categories. First, there are the direct effects of the sediments. These sediments settle to the bottom of some body of water and smother some of the bottom organisms. They reduce penetration of light, thus affecting the photosynthesis processes. They also have an aesthetic effect. Second, the sediments act as carriers of potentially pollutional materials. Third, they place varying oxygen demands on the water body. Animal waste and crop residue that forms a part of the sediments in a total sense are organic materials and will utilize oxygen in their decomposition. Different sections of Public Law 92-500 are given in relation to the control of nonpoint sources or agricultural sediments. Mr. Shilling believes that local expertise must be involved from the beginning in the planning, development, and inplementation of the management programs. Four items which he deems important are: (1) if a control program for agricultural sediments is to be effective, it must be tailored to local conditions, (2) we must determine our priorities and develop and implement an effective control program, (3) a distinction must be made between soil conservation and water quality protection, and (4) 208 planning and 305 (b) state reports preparation are either ongoing or being initiated, and those with specific knowledge in the control of agricultural sediments should make their expertise available for these efforts. (Cameron-East Central)

## 2982 - A3, A4, A11, A12, C3, F2
## STATES ROLE IN FORMULATING CONTROL STRATEGY,

Secretary of Health and Environment, Kansas State Department of Health and Environment
D. F. Metzler
Agriculture and Clean Water—Proceedings of a Conference to Explore Control Strategy for Agricultural Nonpoint Source Water Pollution, Kansas City, Missouri, April 3, 1975, p. 83-92.

Descriptors: Sediments, Water pollution control, Agriculture, Nitrogen, Kansas.
Identifiers: Fecal coliforms.

Mr. D. F. Metzler states that in the Kansas area, the problem of controlling agricultural pollution is caused by too much sediment and too much nitrogen. He feels in order to develop a strategy which is rational in controlling the pollution, one should ask—does it affect human health, is it needed because it affects human health, is it needed because it improves the quality of fish or wildlife, or is it needed in order to control algal growth or the growths of weeds. Every river basin is different and different control strategies are required. Most of the time, all the major streams within Kansas are in compliance with the standards which Kansas has adopted and which are a part of the standards filed with EPA. The total dissolved solids concentration and the fecal coliform content represent the areas of most frequent violation. Fecal coliform violations occur usually as a result of rainfall and excessive runoff or snowmelt and the accompanying runoff. The fecal coliform standard was violated approximately 25 percent of the time directly as a result of nonpoint source runoff. The fecal coliform effluent limitation for treated domestic wastewater discharges are 200 fecal coliforms per 100 ml, and this is an extremely stringent limit; few wastewater discharges in Kansas now meet it. However, at low stream flow, the fecal coliform standards of 400/100 ml in Class A waters and 2,000/100 ml in Class B waters are rarely violated. In summary, the solution to the control problem requires careful planning and a rational approach. It requires major financial commitment on the part of the agricultural industry, and government. (Cameron-East Central)

## 2983 - A8, B2, B3, C1, C2 C3, D2, D3, E2, E3
## PROPERTIES RELATED TO UTILIZATION,

Department of Agricultural Engineering, University of Illinois at Urbana-Champaign
D. L. Day and B. G. Harmon
Presented at the Animal Waste Conference, ASAE Committee SE-412, Chicago, Illinois, December 11-12, 1972, 11 p. 7 tab, 21 ref.

Descriptors: Animal wastes, Physical properties, Chemical properties, Biological properties, Livestock, Recycling, Fuels, Pyrolysis, Hydrogenation, Nutrients.
Identifiers: Refeeding, Land disposal, Soil builders.

Throughout the ages, the major methods of livestock manure utilization have been (a) spreading on cropland for crop production and to build the soil, (b) consumption of manure by animals (coprophagy), and (c) heating (manure pack and burning dried dung). This paper reviews properties of livestock manures that are of interest for utilizing the manure as crop nutrients, soil builders, animal nutrients, and fuels. Physical, chemical, biological, and thermal properties are discussed as related to some current utilization methods. At least sixteen elements are considered necessary for the growth of green plants. These are: carbon, hydrogen, oxygen, nitrogen, phosphorus, sulfur, potassium, calcium, magnesium, iron, manganese, zinc, copper, molybdenun, boron, and chlorine. Practically all of these plant nutrients can be found in manure. Animal waste, as excreted, consists of undigested and unabsorbed feed ingredients, catabolic products of metabolism, expended secretions, and tissue and microbial cells. Because these contain both organic and inorganic dietary essentials for animals, refeeding of these wastes has been found feasible. Production of gas and oil from manure has been developed by two processes. One is a pyrolysis method in which the manure is heated for about six hours at about 900 degrees C in a closed system at atmospheric pressure without the addition of air or other gas. The manure is converted to gas, oil, and solids, all of which can be used as fuels. The second method, hydrogenation, consists of heating the manure for twenty minutes at 380 degrees C under pressures of 2,000 to 6,000 p.s.i. in the presence of carbon monoxide and steam. Because of the calcium, sodium, and potassium content of the manure, the addition of catalysts is not necessary. The resulting product is a heavy, largely parafinic oil with a heating value of 14,000 to 16,000 Btu per pound. (Cameron-East Central)

## 2984 - C2, D1, D2, E3, F1
## THE POTENTIAL OF MANURE PYROLYSIS FOR AMMONIA PRODUCTION AND ELECTRIC POWER GENERATION IN KANSAS,

Department of Chemical Engineering, Kansas Agricultural Experiment Station, Manhattan
C. R. Engler, W. P. Walawender, and L. T. Fan
Contribution No. 39, Department of Chemical Engineering, Kansas Agricultural Experiment Station (Project Ch.E. 0880-Feedlot Waste Conversion), Manhattan, Kansas, 16 p. 3 fig, 4 tab, 5 ref.

Descriptors: Recycling, Ammonia, Electric power, Kansas, Costs.
Identifiers: Feedlot wastes, Pyrolysis, Synthesis gas.

To determine the potential for large capacity pyrolysis plants in Kansas, feedlot manure generation and possible synthesis gas usage in the southwest quarter of the state were studied. Feedlot capacity data were collected and organized into regions that could support moderate-to large-scale pyrolysis plants. The process consisted of a feed preparation section where incoming manure was dried and ground, a pyrolysis section where the manure was gasified at 1500 degrees F in a fluidized bed reactor, and a gas clean-up section where $CO_2$ and other undesirable gaseous by-products were removed. Heat requirements for the pyrolysis reactor and manure drying were supplied by burning char in a fluidized bed combustion reactor. Annual operating costs for a moderately large plant processing 2500 T/D would be approximately $10 million. Assuming the manure would be available within an average hauling distance of 25 miles, the cost basis for transportation would be $0.06/T/mile. The annual usage of nitrogen from commercial fertilizers was estimated for the southwest quarter of Kansas in order to determine the potential contribution of manure synthesis gas. Based on sales reported for that area, approximately 175,000 T of nitrogen were used annually, which is equivalent to 212,000 T of ammonia. Feedlot manure could be used as fuel for the small generating plants in western Kansas. However, it would not be economical to gasify the manure since low-capacity pyrolysis plants are quite expensive. An alternate route would be direct combustion of the manure to fire steam boilers. Results show that the potential for utilization of synthesis gas from moderate-to large-scale manure pyrolysis plants appears to be good for southwestern Kansas. In particular, either producing ammonia or generating electricity could directly benefit feedlot operators and other residents of the area. (Cameron-East Central)

## 2985 - A11, A12, E3, F2
## ANIMAL SCIENTIST WARNS RESTRICTIONS COMING ON RECYCLING, ANTIBIOTIC USES,

Beef, Vol. 12, No. 7, p. 17, March, 1976

Descriptors: Feed additives, Legal aspects, Antibiotics, Cattle, Nitrates, Nitrites.
Identifiers: Refeeding, Restrictions, Food and Drug Administration, Drug residues, Chemical residues.

Bill Hale, University of Arizona animal scientist, reported on the drug and chemical residue problems in cattle at a meeting of the ANCA environmental sciences committee at Phoenix. Hale warned: (1) The latest FDA efforts seem to be that new rules would eliminate both DES and other growth promotants, such as Ralgro and Synovex-with far reaching consequences to the cattle industry. (2) Restrictions on low-level antibiotic feeding are possible in the near future. The rules probably will prevent using any antibiotic for low level feeding that is also used in human medicine. Also it is likely that any new antibiotic will be quickly moved from livestock to human use, and taken out of the livestock medicine chest. (3) With six states already having rules about refeeding livestock wastes, the FDA probably will stay out of the refeeding problem. (4) The increase in the number of pesticide and herbicide residues in beef cattle carcasses is liable to continue. Cattlemen who feed byproducts need ways to check for chemicals on the byproducts. (5) There is a nitrate and nitrite question in cured meats. Hale warned the ANCA session that a lot of beef goes into sausage, which might be hit hard if the feed preservatives were outlawed. He also noted that the current publicity is unfair—since only 20 per cent of the nitrates and nitrites in a human diet come from cured meat. The other 80 per cent comes from natural levels in vegetables. (Cameron-East Central)

## 2986 - A11, A12, B2, B3, C2, C3, D1, D2, D3, E3, F4
## RECYCLING ANIMAL WASTE AS A FEEDSTUFF: A REVIEW,

Consultant, World Bank Project, Adakale Sokak No. 51, Yenisehir, Ankara, Turkey
A. N. Bhattacharya and J. C. Taylor
Journal of Animal Science, Vol. 41, No. 5, p. 1438-1457, November, 1975. 5 tab, 25 ref.

Descriptors: Recycling, Literature review, Poultry, Cattle, Sheep, Feed additives, Performance, Chemical properties, Biological properties, Nutrients, Diseases, Public health, Arsenic, Antibiotics, Hormones, Pesticides, Waste storage, Microorganisms, Waste treatment, Physical treatment, Chemical treatment.
Identifiers: Refeeding, Swine, Broiler litter, Animal health.

The solid waste from farm animals in the United States is estimated at two billion tons annually. It is also estimated that 50 percent of these wastes are produced by intensive animal production systems. Studies have been conducted and others are planned which have been designed to establish the safety of processed animal wastes to animal and man. This paper summarizes the available information on: (1) the nutritional value of different kinds of animal wastes as feed for livestock and poultry; (2) the identity of possible agents which may cause human and animal health hazards; and (3) the effect of processing methods on the safety of such animal waste feed. (Cameron-East Central)

## 2987 - A5, B2, B4, E2, F1
## LAGOON LINER STOPS SEEPAGE,

Successful Farming, Vol. 74, No. 5, p. H24, March, 1976. 1 fig.

Descriptors: Lagoons, Seepage, Waste storage, Costs.
Identifiers: Swine, Liners, Manure, Chlorinated polyethylene, Land disposal.

Because light, sandy and very permeable soil posed a problem for a lagoon system, Boar Power (a breeding stock firm) selected a reinforced chlorinated polyethylene liner for the lagoon. This type of material is used for similar purposes at chemical manufacturing plants. The liner is 30 mils thick and costs approximately $10,000, including installation. Minimum expected life for the liner is 20 years. Jim Church, supervisor of the project says the plan is to pump out of the lagoon, losing nothing through seepage. Stewart Melvin, Iowa State agricultural engineer, says it would be difficult to justify that kind of expense for a commercial operation, but says lagoons of this type plus a low-cost irrigation system "could be the most practical" hog waste disposal system. (Cameron-East Central)

## 2988 - B2, C2
## DETERMINATION OF AMMONIUM NITROGEN IN ANIMAL SLURRIES BY AN AMMONIA ELECTRODE,

The Agricultural Institute, Johnstown Castle, Wexford, Ireland
E. Byrne and T. Power
Communications in Soil Science and Plant Analysis, Vol. 5, No. 1, p. 51-65, 1974. 4 tab, 6 ref.

Descriptors: Nitrogen, Slurries, Cattle, Poultry, Measurement.
Identifiers: Ammonia electrode, Ammonium, Extractants, Swine.

The use of the Orion ammonia electrode technique to measure ammonium nitrogen in animal slurries is described. The twenty-two animal slurries used were selected from various sources and include a range of cattle, pig and poultry samples. Four different extraction times were tried for both 0.1N HC1 and $H_20$, "Quick" (10 secs.), 10 minutes, 1 hour and 16 hours. Analysis of the "HC1" data showed no difference between times of extraction. In the "$H_20$" series the overnight result was significantly lower (P less than .001) than the other times between which there was no difference. Extraction with 0.1N HC1 gave a result intermediate between the 0.1N HC1 and $H_20$. For all samples the 0.1N HC1 result was higher than the H20 result. Results indicated that several extractions are necessary to remove all the water soluble ammonium. One extraction with 0.1N HC1 will remove the same amount. Conclusions showed that the ammonia electrode is rapid and sufficiently accurate for the determination of ammonium in animal slurries. No interference effects were detected and it compares satisfactorily with the distillation procedure. Ammonium nitrogen, closely related to soluble nitrogen in animal slurries, may be used to give an estimate of the total nitrogen content, or could be used to indicate the efficiency of the slurry relative to fertiliser nitrogen. (Cameron-East Central)

## 2989 - B2, B3, B4, B5, D1, D3
## STATE OF THE ART OF THE PREPARATION TECHNIQUE OF LIQUID MANURE,

A. G. Forster
Landtechnik, No. 22, p. 584-586, November, 1971. 4 fig.

Descriptors: Liquid wastes, Waste treatment, Physical treatment, Biological treatment, Solid wastes, Lagoons, Drying.
Identifiers: State of the art.

Several methods of preparing liquid manure are known. Mechanical treatment is performed by centrifuge, decanter, screening machine, or mangle. It serves the purpose of separating liquid from solid substances, in order to economize the storage of the manure or to treat the liquid biologically as in Italy, England, or the United States. The thermal treatment, drying the dung, deodorizes, sterilizes, and reduces volume but it does not solve the emission problem. In the biological method, microorganisms decompose the organic substance in the dung. In the anaerobic process, microorganisms take the necessary oxygen from oxygen compounds like nitrates; however, this process does not furnish many final products, but a lot of intermediate products which can still be oxidized. For highly concentrated liquids, like manure, this process is not adapted. In the aerobic process, organic compounds oxidize into carbon dioxide and water; the developing energy is used for further cell construction. The aerobic process can be conducted in cold, warm and hot treatment systems. Cold treatment systems can be placed outside, like oxidation ditches. Outside systems are storage bins, oxidation towers, and aerobic lagoons. Both systems handle only easily decomposable substances but not the total organic substance. (Solid Waste Information Retrieval System)

## 2990 - B2, B3, B5, D1, D3, E3
## HOW ONE TRIES IN THE USA TO SOLVE ANIMAL WASTE PROBLEMS?,

G. Blanken
Landtechnik, Vol. 23, No. 24, p. 609-612, December, 1971. 7 fig.

Descriptors: Lagoons, Liquid wastes, Drying, Recycling, Humus.
Identifiers: Oxidation ditch, Composting, Soil amendments.

The most economic method of disposing of animal waste is the lagoon, into which the animal waste is led. Another method is removal by oxidation ditches, which are situated directly under the stable floor, provided with gaps. The ditches are connected with each other, so that liquid manure can circulate; this is effected by a rotor provided with brushes. The rotor also continuously adds oxygen to the manure, to promote decomposition. Tests have been done to transform manure into dry feces or humus, by continuous air ventilation in the stable, and by using a revolving device, in the ditches, which dries the manure down to 30 percent water. A special kind of compost is prepared by adding bark flour to the manure. This mixture is kept in clamps and then processed into flower soil. (Solid Waste Information Retrieval System)

## 2991 - A6, B3, D1
## MOLE MOUNDS—A NEW SYSTEM OF MANURE REMOVAL,

Landtechnik, Vol. 26, No. 10, p. 263, May, 1971.

Descriptors: Waste storage, Solid wastes.
Identifiers: Mounding, Mole mounds, Sweden.

A new method of cleaning cattle barns has been developed in Sweden. A hydraulically driven piston presses the dung from the stable into the dung stock through a subterranean tube system, 180 mm in diameter. The tube system is protected against freezing by the soil; the opening of the tube is protected by the dung itself. The new dung settles in the middle of the mound which avoids bad odor formation. The tube system is independent of the quality and quantity of dung. (Solid Waste Information Retrieval System)

## 2992 - A6, B1, C2, D1, D2, D3, F3
## ENGINEERING CHALLENGES OF ANIMAL PRODUCTION ODOR CONTROL,

Department of Agricultural Engineering, Oregon State University, Corvallis
J. R. Miner
Presented at the Second National Conference on Complete Water Reuse: Water's Interface with Energy, Air and Solids, Chicago, Illinois, May 4-8, 1975, 16 p. 1 fig, 3 tab, 20 ref.

Descriptors: Feedlots, Management, Biological treatment, Physical control.
Identifiers: Odor identification, Odor measurement, Odor control, Olfaction, Chemical treatment.

This paper examines the nature of livestock odors, their identification, measurement and control, and design and management techniques that facilitate their control. Odor contributors are fresh manure, livestock feeds, and odors from the animals themselves. Among the theories of olfaction, the stereochemical theory of Amoore is one of the most popular. According to this theory, there are different kinds of receptor sites. By determining the silhouettes of various molecular models of compounds known to have similar odors, these sites may be described. By combination of more than one primary odor being received simultaneously it is possible to fabricate a large number of different combinations based upon relative concentrations. The most accepted method for evaluating odor concentrations has been the measurement of odor intensity based upon the number of dilutions required to reduce the concentration to a barely detectable level. This measurement may be accomplished by use of a Scentometer. Among chemicals used to control odor are: potassium permanganate, potassium nitrate, paraformaldehyde, hydrogen peroxide, and Ozene. Enzymes and other digestive aids have also been proposed for the control of livestock production odors. Feed additives for this purpose are also being researched. Because current levels of understanding of odor control by chemicals, feed additives, or odor-masking techniques are not sufficient to offer solutions to livestock producer problems, site selection, facility design, and careful management assume great importance in the prevention of odor and the prevention of odor complaints by neighbors. Further research is needed to evolve odor control systems which are compatible with intensive livestock production and which are economically compatible with the problem. (Penrod-East Central)

## 2993 - A2, A4, B2, C1, C2, C3, D3, E2, F1
## WATER QUALITY IMPLICATIONS OF LIVESTOCK PRODUCTION,

Department of Agricultural Engineering, Iowa State University, Ames
T. E. Hazen, D. H. Vanderholm, and J. R. Miner
Ames Reservoir Environmental Study. Appendix 4. Physical Relationship With the Agricultural Sector, Iowa State University Report ISWRII-60-A4, 1973, p. 4-4-i—4-4-32. 13 tab, 13 ref.

Descriptors: Waste disposal, Water quality, Farm wastes, Water pollution control, Waste treatment, Economics, Farm management, Cost analysis, Capital costs, Operating costs, Iowa, Feedlots, Runoff, Reservoirs, Physical properties, Chemical properties, Biological properties, Watersheds.
Identifiers: Ames Reservoir (IA), Skunk River Basin (IA), Land application.

Animal wastes are major water pollution sources; however, the impact of such wastes can be controlled through alternative management techniques. A survey of the literature indicates that the application of wastes by spreaders, manure tank wagons, and irrigation can reduce to less than 1 percent the portion of excreted pollutants escaping into the environment. Treatment methods, including oxidation ditches, anaerobic and aerated lagoons, are also considered although none yield acceptable effluent for surface water courses. The impacts of animal waste and potential management policies on the water quality of Iowa's Ames Reservoir basin is evaluated. Though livestock production in the region is not intensive—no cattle or swine operations exceed 1000 head—it is still of major importance. Over 2 million pounds of manure are produced daily most of which is applied to cropland. Management practices including prevention of direct waste discharges, locating feed lot boundaries away from streams, and fencing animals where they might disturb banks are recommended. Runoff control costs vary from $1.00 to $10.00 per head according to feed lot size. Manure management, loss of grazing areas adjacent to water, and aesthetic conservation are also costs to be evaluated. (Schroeder-Wisconsin)

## 2994 - A8, C2, E2

## DENITRIFICATION IN SOIL TREATED WITH BEEF-FEEDLOT MANURE,

Minnesota University, Northwest Experiment Station, Crookston
G. W. Wallingford, L. S. Murphy, W. L. Powers, and H. L. Manges.
Communications in Soil Science and Plant Analysis, Vol. 6, No. 2, p. 147-161, 1975. 6 fig, 1 tab, 8 ref.

Descriptors: Denitrification, Soils, Cattle, Feedlots
Identifiers: Land disposal, Nitrogen loss.

Yearly fall applications of beef feedlot manure were begun in 1969. Four plots were selected for detailed study in the summers of 1972 and 1973 to determine if denitrification significantly affected the N balance of an irrigated silty clay loam soil. The four plots received 0, 58, 306, and 68 t/ha/yr of dry manure by the summer of 1973. Nitrogen balance calculations showed that large amounts of N were not accounted for by soil and manure analyses. Of the plots receiving manure, the plots receiving the heaviest manure treatments had the least amount of unaccountable N loss. Atmospheric and other soil analyses suggested that N loss could have occurred from denitrification reactions. Organic carbon increased relative to the control at the 10-cm depth in all three manured plots in 1972 and movement of C to the 50-cm depth was evident in the plot that had received 687 t/ha/yr. Some of the increased C would be available for oxidation in denitrification reactions. The 1973 data showed lower percentages of $N_2$ at all depths beneath the plot that received 687 t/ha/yr of manure. In 1972 lower percentages of $0_2$ were found at several depths beneath the plots receiving 687 t/ha/yr of manure; in 1973 they were lower beneath plots receiving 306 and 687 t/ha/yr. The 1972 samplings revealed higher $CO_2$ percentages in the surface 40 cm under plots receiving 687 t/ha/yr than under the control plots; 1973 samplings revealed higher $CO_2$ percentages at all sampling depths beneath plots receiving 306 and 687 t/ha/yr. No $CH_4$ or $N_20$ was found in the 1972 gas samples. Because $N_20$ is an end product of denitrification its presence indicates that denitrification did occur. It was shown that in land disposal of manure, the potential for $NO_3$-N contamination of groundwater can be lowered by denitrification. (Cameron-East Central)

## 2995 - A7, C2, B1 200

## ATMOSPHERIC AMMONIA AND RELATED NITROGEN GASES EMANATING FROM DAIRY WASTE,

USDA, ARS, California University, Riverside
R. E. Luebs
Summaries of papers, Statewide Conference on Fertilization and Waste Management in Relation to Crop Production and Environmental Problems, University of California, Riverside, December 18-19, 1972. p. 22-23.

Descriptors: Dairy industry, Air pollution, Ammonia, Nitrogen, Gases.
Identifiers: Volatilization.

Distillable nitrogen was measured as an air pollutant in 2 different dairy areas in southern California. Data were obtained (1) in and around an area of 150,000 dairy animals in 60 square miles and (2) around a 600-cow dairy isolated from other major ammonia sources. Absorption by acid surface traps for a 39 week period indicated that distillable nitrogen concentration in the atmosphere averaged 28 times that in an urban area. The following conclusions were drawn from data related to Area I (150,000 cows): (1) Volatilization increased atmospheric concentrations of distillable nitrogen over an area of 210 square miles. (2) Three-fourths of this area was downwind. (3) Concentrations in the dairy area away from the cows were inversely correlated with average weekly wind speed. (4) Nitrogen content of rainfall in the large dairy area was 200 percent greater than at an urban sampling site. (5) Approximately 20 percent of the nitrogen absorbed by the acid-surface traps was not ammonia nitrogen. Area II (600-cows) yielded these conclusions: (1) Maximum concentration of distillable nitrogen along the fence was 1081 ug per cubic meter of air, as compared with 15 ug at a distance of .6 mile during the same period. (2) Highest concentrations of distillable nitrogen were always much higher along the downwind fence. (3) During a period of high volatilization and continuous wind averaging 5 miles per hour, the maximum distance from the dairy that increased distillable nitrogen concentrations could be detected was about 1600 feet. Data showed great diurnal variation in atmospheric concentrations of distillable nitrogen and in the patterns of this variation, depending on factors affecting volatilization, temperature inversions in the atmosphere, and proximity to the source. (Cannon-East Central)

## 2996 - A5, A8, C2, E2

## LAND DISPOSAL OF MANURE,

Agriculturist, California University Agricultural Extension, Modesto
J. L. Meyer
Summaries of papers, Statewide Conference on Fertilization and Waste Management in Relation to Crop Production and Environmental Problems, University of California, Riverside, December 18-19, 1972. p. 23-25. 3 fig.

Descriptors: Fertilizers.
Identifiers: Land disposal, Nitrates, Salts, Leaching, Soil profiles.

Large amounts of fertilizer applied to the soil can produce excessive amounts of nitrate-nitrogen and salts which become available for leaching into ground waters. The presence or absence of restrictive soil layers and their effect upon leaching will affect manure rate usage. In Central San Joaquin Valley, under restricted soil (hardpan), nitrogen movement seems to be a lesser problem than under open soils. For 12 consecutive years, 12 yards of dairy manure plus 150 pounds of commercial nitrogen were applied per acre to an area where restrictive soil was present at 18 feet. When cropped to silage corn and winter oats, no excess movement or accumulation of nitrogen occurred. A slight increase in nitrates and salinity was observed just below the root zone of growing crops. During the 12-year study, 40 yards of manure and 150 pounds of commercial nitrogen were also applied to separate plots of soil under the same conditions. Silage corn and winter oats were also grown on these plots. This results in both salt and nitrogen accumulations at the soil surface, under the root system, and lower in the profile. Accumulations lower in the profile were probably caused by successive irrigations. Manure amounts greater than crop requirements, perhaps 12 to 20 yards per acre, may cause nitrogen and salt leaching below crop root systems in open soils and slight salt accumulations in restricted soils. (Cannon-East Central)

## 2997 - A8, B2, B3, C2, E2

## NITRATE CONTENT OF BARLEY AND SUDANGRASS IN RELATION TO RATES OF BOVINE WASTES AND WATER,

Professor, Soil Science and Agricultural Engineering, California University, Riverside
P. F. Pratt, R. G. Sharpless, and K. M. Holtzclaw
Summaries of papers, Statewide Conference on Fertilization and Waste Management in Relation to Crop Production and Environmental Problems, University of California, Riverside, December 18-19, 1972. p. 25-26.

Descriptors: Nitrates, Crop response, Barley, Sudangrass, Evapotranspiration.
Identifiers: Land application, Hanford sandy loam, San Emigdio clay, Arlington sandy loam.

In the fall of 1970, dry dairy manure at rates of 0, 20, 40, and 80 tons per acre per year, and a liquid manure from a feedyard at rates of approximately 13 to 26 tons of air dry material per acre per year, were added to plots of Hanford sandy loam. Forty tons per acre per year of dry dairy manure was applied to plots of Arlington sandy loam and San Emigdio clay soils as well. Water at rates equal to evapotranspiration (ET) and at ET + 33 percent were imposed on all manure rates. Barley was grown in winter and sudangrass was grown in the summer. In most cases, the higher water rates reduced the $NO_3^-$ content of the forage, sometimes by 80 percent or more. During the first year results showed sudangrass to have unsafe levels of $NO_3^-$ in each of its 3 cuttings from plots receiving liquid feedyard manures. Unsafe $NO_3^-$ levels were shown in forage from the Hanford soil receiving rates of forty and eighty tons of dry manure. At the twenty ton rate, the forage had unsafe levels at the low water rate and safe levels at the high water rate. In most cases, the barley showed safe $NO_3^-$ levels. In the second year, the twenty ton rate of dry manure showed safe levels in all cases. At forty and eighty ton rates of dry manure and at both liquid manure rates, unsafe $NO_3^-$ levels were found. Also, sudangrass had higher $NO_3$ contents in the low as compared to the high water rates and higher $NO_3^-$ contents in the Hanford as compared to the Arlington and San Emigdio soils. (Cannon-East Central)

## 2998 - A8, B2, E2

## EFFECT OF VARIOUS APPLICATION RATES OF DAIRY WASTE EFFLUENT ON PRODUCTION OF CORN SILAGE IN A PERCHED WATER-TABLE AREA,

Agriculturist, California University Agricultural Extension, Hanford
S. W. Kite, R. S. Rauschkolb, and R. S. Ayers
Summaries of papers, Statewide Conference on Fertilization and Waste Management in Relation to Crop Production and Environmental Problems, University of California, Riverside, December 18-19, 1972. p. 26-27.

Descriptors: Rates of application, Effluents, Crop response.
Identifiers: Dairy wastes.

In October, 1970, the effects of various rates of dairy waste effluent on soil productivity were studied. The soil was a Tulare fine sandy loam with the water table at approximately forty inches. The effluent was a liquid mixture of dairy manure and wash water. During first year, plots were treated with high, intermediate, and low volumes of the effluent and a control. The following year, the intermediate volume was replaced by intermittent flooding. Ceramic cups were installed at various depths in the soil under the continuously flooded plots to monitor changes in the soil solution. Corn silage was produced each year after the flooding to determine any effect of effluent loading on yields. Nitrogen treatments were superimposed on the plots during the second year to evaluate nitrogen response under different loading rates. There were no differences in the yields of either year. Soil and soil solution analyses suggested that phosphorus and nitrogen move downward through the soil as water-soluble organic compounds. Nitrate-nitrogen levels decreased to less than 1 ppm in the soil solution because of denitrification caused by the flooding application of the effluent. (Cannon-East Central)

## 2999 - A8, C2, E2

## DAIRY MANURE RATES RELATED TO GREEN CHOP PRODUCTION,

U. S. Department of Agriculture, Agricultural Research Service, Western Region, Riverside, California

S. Davis
Summaries of papers, Statewide Conference on Fertilization and Waste Management in Relation to Crop Production and Environmental Problems, University of California, Riverside, December 18-19, 1972, p. 27-29. 1 fig, 1 tab.

Descriptors: Crop response, Nitrogen, Salts, Barley, Sudangrass, Soils.
Identifiers: Land disposal, Application rates.

In a field manure trial, three soil types in three locations were studied to determine the amounts of manure that can be applied to soil without reducing production. Nitrogen and salt movements resulting from these applications were also studied. Barley was grown in the winter and sudangrass in the summer for green chop feed. Dry manure was applied at the three locations at rates of 0, 20, 40, and 80 tons per acre per year, and 38 and 76 liquid tons per acre per year. At the Hanford site, the results showed a considerable decrease in barley and sudangrass production for the 80 ton per acre rate of dry manure and a fairly high decrease for the 76 ton per acre wet-manure rate. At 40 tons of dry manure per acre, Hanford soils produced an average of 3687.66 pounds per acre, Ramona soils an average of 4200.33 pounds per acre, and Moreno soils an average of 3545.33 pounds per acre of barley. Hanford soils produced an average of 4151.66 pounds per acre, Ramona soils an average of 3518.5 pounds per acre, and Moreno soils an average of 3398.33 pounds per acre of sudangrass. (Cannon-East Central)

## 3000- A11, B1, E3

### EVALUATION OF DEHYDRATED POULTRY WASTE FROM CAGE REARED BROILERS AS A FEED INGREDIENT FOR BROILERS,

Research Department, Crawfords Foods Limited, Wynyard, Saskatchewan SOA 4TO and Department of Poultry Science, University of Saskatchewan, Saskatoon, Saskatchewan S7N OWO
K. K. Bhargava and J. B. O'Neil
Poultry Science, Vol. 54, No. 5, p. 1506-1511, September, 1975. 8 tab, 15 ref.

Descriptors: Feeds, Poultry, Growth rates, Performance.
Identifiers: Dehydrated poultry wastes, Feed efficiency.

A study was performed to observe the growth performance of broiler chicks fed dried poultry waste from cage reared broilers. Straight-run day-old Peel broiler chicks were used in all experiments. In experiment 1, chicks 4 weeks of age were tested for the effects of DPM on their growth response. In experiment 2, chicks were fed a commercial broiler starter for 4 weeks and then randomly assigned to experimental rations of either 5 or 10 percent DPW. Experiment 3 diets were computed to be isocaloric and isonitrogenous. To test the availability of methionine and lysine in experiment 3 diets, experiment 4 was designed to ascertain the response of chicks to diets containing the same levels of DPW as in test 3, but with additional amounts of the 2 amino acids or a combination of both. Data from experiment 1 showed that there was a significant depression in growth when chicks were fed 10 percent DPW, but levels of either 15 or 20 percent DPW did not result in a further depression. The 10 percent diet significantly decreased feed efficiency. A further depression of feed efficiency was observed with the 14-20 percent feedings. Performance index was significantly lower with the addition of any level of DPW. Experiment 2 results showed that the inclusion of 10 percent DPW into the ration resulted in a significant decrease in body weight at about 8 weeks. No significant differences were observed in feed efficiency or performance index. The results of experiment 3 showed that levels up to 20 percent DPW had no adverse effects on growth characteristics and carcass quality. Data from experiment 4 indicated that availability of both lysine and methionine was similar irrespective of the percentage of DPW included in the diets. (Penrod-East Central)

## 3001- A11, A12, F6

### ELIMINATION OF SULFAMETHAZINE FROM EDIBLE TISSUES, BLOOD, URINE, AND FECES OF TURKEY POULTS,

Division of Veterinary Medical Research, Food and Drug Administration, Beltsville, Maryland
G. E. Heath, D. A. Kline, C. J. Barnes, and D. H. Showalter
American Journal of Veterinary Research, Vol. 36, No. 7, p. 913-917, July, 1975. 6 fig, 3 tab, 11 ref.

Descriptors: Public health.
Identifiers: Drugs, Sulfamethazine, Animal diseases, Turkey poults, Metabolites, Blood samples, Tussie samples, Residue depletion, Elimination, Urine, Feces, Drug withdrawal.

The objective of this study was to determine the rates of depletion of free (unaltered) sulfamethazine from blood and several edible tissues of turkey poults given usual therapeutic doses. Tissue samples were analyzed for free sulfamethazine using Tishler's method; sensitivity of the method was found to be 0.1 ppm. Blood samples were analyzed by Annino's method; sensitivity was found to be 1 ppm. Data generated from the study supported the view that sulfamethazine undergoes elimination at an exponential rate from the various tissues and blood of turkey poults. However, this generalization did not hold true at small concentrations in kidney, liver, and skin; these organs seemed to retain the parent compound at concentrations ranging from 0.1 to 0.4 ppm. The authors concluded that since only 8.6 percent of the oral dose and 16.5 to 17 percent of the intravenously administered dose was recovered in urine-feces as the parent sulfamethazine, it was indicated that the drug might be extensively metabolized. (Penrod-East Central)

## 3002 - A8, B3, C2, E2, F6

### POTASSIUM IS RESPONSIBLE FOR SALINITY IN SOILS AMENDED WITH POULTRY MANURE,

Department of Plant Science, Delaware University, Newark
W. C. Liebhardt and J. G. Shortall
Communications in Soil Science and Plant Analysis, Vol. 5, No. 4, p. 385-398, 1974. 5 fig, 3 tab, 17 ref.

Descriptors: Soils, Salinity, Potassium.
Identifiers: Land disposal, Poultry manure, Application rates.

Research was done to determine which ion(s) are responsible for the high salinity associated with poultry manure applications on coastal plain soils. Applications of poultry manure were made each March in 1971, 1972, and 1973 and plowed into an Elkton sandy loam at rates of 0, 22, 56, 90, 165 and 224 Mt/ha. In addition, there was a fertilizer treatment of 224-5-186 kg/ha (N-P-K) and a treatment consisting of 22 Mt/ha of poultry manure plus the previous fertilizer treatment. As rates of poultry manure application increased, electrical conductivity and concentrations of double acid extractable and $H_20$ extractable cations increased. Potassium in the soil was also elevated by increasing rates of poultry manure. Double acid and water extractable K increased six and ten fold, respectively, over the range of applications made in this study. Water extractable K, however, was much higher than either Ca or Mg, making K the prime suspect for the increasing salinity associated with poultry manure. The high coefficient of determination ($r^2 = .95$ and $r^2 = .97$) further indicated a highly linear relation between K and salinity. Sodium and ammonium were also contributors to the salinity problem, however, they were considerably less important than K. Data also substantiated the relative unimportance of Ca and Mg, as concentrations were generally less than 100 PPM. In conclusion, it would appear that K was primarily responsible for the salinity associated with heavy applications of poultry manure on sandy coastal plain soils. (Cameron-East Central)

## 3003 - A7, A11, B1

### EVALUATION OF AMMONIA AND INFECTIOUS BRONCHITIS VACCINATION STRESS ON BROILER PERFORMANCE AND CARCASS QUALITY,

Department of Animal Science, Colorado State University, Fort Collins
C. L. Quarles, and H. F. Kling.
Poultry Science, Vol. 53, P. 1592-1596, 1974. 1 fig. 4 tab, 11 ref.

Descriptors: Ammonia, Poultry, Performance, Air pollution.
Identifiers: Infectious bronchitis vaccination, Broiler chicks, Animal health.

The response of broilers to infectious bronchitis vaccine and atmospheric ammonia was studied. Eighty Indian River Cross male broiler chicks were randomly assigned to each of 12 chambers in a controlled environment building. Anhydrous ammonia gas was injected into the test chambers at rates of 0, 25, and 50 ppm of $NH_3$ during the time period when the chicks were 4-6 weeks of age. The chicks were vaccinated at 5 weeks of age, with a commercial strain of infectious bronchitis dust vaccine. At 8 weeks of age, body weights and feed efficiencies of broilers exposed to ammonia were significantly reduced. At 6 and 8 weeks of age, some severe cases of airsacculitis existed in chicks in the 25 and 50 ppm $NH_3$ chambers. During the eight week period, airborne bacteria were significantly greater in the 25 and 50 ppm $NH_3$ chambers. Results on carcass quality showed that low levels of ammonia and infectious bronchitis stresses may not affect carcass tenderness, flavor, or juiciness. However, such stresses can have an economically detrimental effect by increasing incidence of breast blisters and condemnation and by decreasing growth performance and grade. (Penrod-East Central)

## 3004 — A8, C2, E2

### DRIED POULTRY MANURE REVEGETATES SPOIL BANKS,

E. L. Bergman and G. W. McKee
Science in Agriculture, Vol. 23, No. 2, p. 8-9, Winter, 1976. 1 tab

Descriptors: Reclamation, Revegetation, Mulching, Nutrients, Potash, Lime, Phosphate.
Identifiers: Dried poultry manure.

Revegetation experiments using dried poultry manure were conducted at nine locations in Lackawanna, Luzerne, and Schuylkill counties of Pennsylvania. It was soon found that the ground must be prepared before the sites could be seeded successfully. It was also found that a heavy application of dried poultry manure, over 1300 lbs. per acre with hydroseeding, prevented germination due to a high chemical salt content. Winter loss of new seedlings was observed when urea was applied too heavily and too early in the fall. Mulching was found to be vital to production of a good stand of grass. The following planting tips resulted from these experiments. (1) The seedbed should be graded to contours to prevent washing out. (2) 800 lbs. per acre of dried poultry manure can be used successfully in establishing a ground cover. (3) Dried poultry manure can be mixed with a 10-20-20- or 0-20-20- fertilizer if higher levels of phosphate and potash are needed. Lime should not be mixed with manure unless an anti-foamant is available. (4) Under the conditions of the experiment, the following gave the best cover: Kentucky 31 tall fescue, 30 lbs. per acre, and Empire birdsfoot trefoil, 20 lbs. per acre, on flat ground — or Penngift crownvetch, 20 lbs. per acre, on slopes. (5) Seeding should be completed by June 15 and can be started as early as possible in spring. If a fall maintenance application is made, it should be applied when vegetation is dormant. (6) Anthracite spoil and refuse banks can be revegetated by use of dried poultry manure since the pH is not very acid. Banks with incinerated materials showed best results. (Penrod-East Central)

### 3005 - A8, A11, B3, E2
### FETILIZATION WITH POULTRY LITTER,

S. R. Wilkinson and J. A. Stuedemann
McGraw-Hill Yearbook of Science and Technology reprint, McGraw-Hill Book Company, Inc., 1974. 2 fig, 9 ref.

Descriptors: Fertilizers, Potassium, Magnesium.
Identifiers: Poultry litter, Land disposal, Animal health, Grass tetany, Fat necrosis, Nitrate toxicity.

The problems of fat necrosis, grass tetany, and nitrate toxicity in cattle grazing fescue pastures heavily fertilized with poultry litter are studied. Fat necrosis, the presence of masses of hard fat primarily in the fatty tissues of the abdominal cavity, was investigated in Kentucky-31 tall fescue pastures fertilized with different amounts of nitrogen. Test results indicated that the incidence of fat necrosis in cows was related to high nitrogen fertilization of fescue pastures rather than to any residual feed additive in the litter or any other factor of the litter except its plant nutrient content. Grass tetany, a complex nutritional disease of ruminants, is associated with low levels of blood magnesium. Recent research has determined that heavy poultry litter fertilization (which adds nitrogen and potassium) is related to an increased incidence of grass tetany in cattle. S. R. Wilkinson, J. A. Stuedemann and associates have developed the promising technique of foliar application of magnesium oxide in sodium bentonite water slurries to prevent hypomagnesemia and grass tetany in cattle grazing where poultry litter was used as a fertilizer. Increased incidence of nitrate toxicity is attributed to such things as: excessive nitrogen fertilization, drought, cloudy weather, herbicides, imbalance of soil nutrients, kind of plant, age of plant, and plant part. Nitrate toxicity is also related to the animal, its health, susceptibility to nitrates, and amount consumed. Health problems encountered in cattle grazing heavily littered pastures are essentially those associated with highly fertilized, intensively grazed, and managed pastures. Control of these problems requires judicious use of poultry litter or fertilizer, good pasture management, and special techniques to supply needed nutrients. (Penrod-East Central)

### 3006 - B3, E2
### CHINA RECYCLES HER WASTES BY USING THEM ON THE LAND,

R. Blobaum
Compost Science, Vol. 16, No. 5, p. 16-17, Autumn, 1975. 3 fig.

Descriptors: Recycling, Animal wastes.
Identifiers: China, Land disposal, Waste management, Night soil.

China recycles a tremendous amount of human, animal, and plant waste. In the winter, an important job is scraping silt and other material from the bottoms of fish ponds, canals, and rivers and applying it to crop lands. Other important sources of fertilizer are night soil (human wastes); garbage; and animal wastes, particularly hog wastes. In fact, pig production is being increased because pigs make such good garbage disposals and because their manure is so valuable. Chinese scientists also espouse high sanitation standards, use of herbal insecticides, crop rotation for weed control, composting of agricultural wastes, green manure crops to increase fertility, propagation of beneficial insects, use of biological controls, and elimination of as many chemicals in the food chain as possible. (Merryman-East Central)

### 3007-A11, B3, C2, C3, E3, F1
### FEEDING DRIED POULTRY WASTE FOR INTENSIVE BEEF PRODUCTION,

Ministry of Agriculture, Fisheries and Food, Boxworth Experimental Husbandry Farm, Cambridge CB3 8NN
J. M. Oliphant
Animal Production, Vol. 18, No. 2, p. 211-217, 1974.

Descriptors: Feeds, Performance, Cattle, Copper, Diets.
Identifiers: Dried poultry manure, Refeeding, Deep litter poultry manure, Battery poultry manure, Pathogens, Carcass grading.

Dried poultry manure was substituted for soya and fish meals in an intensive beef ration to determine if it was a satisfactory alternative source of nitrogen and in an attempt to reduce feed costs. During the 3 years of experimentation, Autumn-born British Friesian male castrates were taken from 150 kg live weight to slaughter at 400 kg on various rations. The treatment rations were made isonitrogenous with the control (14.5 percent crude protein). Mean values for animal performance and feed intake were calculated. The reduced live-weight gain in animals receiving the deep litter poultry manure diet was significant in 1969 and 1971, and was associated with reduced daily intakes of dry matter and poorer conversion ratios. Values for the 'mixture' diet were usually intermediate between those for the control and the deep litter poultry manure diets and none of the differences were significant. Performance on the battery poultry manure diet was similar to that on the control diet, except for a poorer feed conversion which was significant in the 1971 trial. Because of the differences in live-weight gain, there were differences in the time taken to reach slaughter weight but, after allowing for differences in the average slaughter weights, the effect was significant only for the deep litter poultry group in 1969. Copper toxicity was not found to be a problem. Examination of the cold carcasses 24 hr after slaughter showed no significant differences, but there was a tendency for diets containing poultry manure to be associated with a lower carcass grading, a lower killing-out percentage and lower scores for round and rump; there was, however, less fat overall and a larger eye muscle and the percentage of hindquarters to whole carcass was higher. It was concluded that dried poultry manure can increase profitability of intensively produced beef. (Penrod-East Central)

### 3008 - A11, B3, C2, E3, F3
### FEEDING BROILER LITTER DIRECT TO RUMINANTS,

Department of Animal Science, Arkansas University, Fayetteville
M. L. Ray
Poultry Digest, Vol. 35, No. 408, p. 73-74, February, 1976. 1 fig, 1 tab.

Descriptors: Feeds, Litters, Cattle, Performance, Additives, Nitrogen, Public health.
Identifiers: Refeeding, Animal health, Digestibility, Arsenic, Zoalene, Amprol, Bloat.

At the Arkansas Agricultural Experiment Station, Fall, 1953, an experiment was started to determine if gestating-lactating ewes would eat chicken litter in adequate amounts to furnish their requirements for supplementary nitrogen without harm to the ewes or their lambs. A second test, using broiler litter as a nitrogen source for fattening steers, was conducted in spring, 1954. There were no excessive feed refusals or digestive disturbances noted in either of the two feeding trials. Two trials were conducted to determine the digestibility of 12 different base materials for broiler litter when fed to steers. Five out of the 12 chicken litters fed were found to be higher in digestible dry matter, digestible energy, and digestible crude protein—oat straw litter, sage grass litter, wheat bran litter, cotton boll hull litter and layer house wood shavings litter. All litters had acceptable digestion coefficients. The most promising use for broiler litter appears to be as a supplement to wintering beef cows and their calfs. No significant difference was noted in arsenic content of liver muscle and fat tissue of steers fed litter rations as compared to those fed the control ration. The fate of Zoalene or its primary metabolite ANOT when used in litter did not accumulate in the steers. Steers consuming Amprol had no Amprol residues in their liver tissues. The most common problem associated with feeding broiler litter is its dusty nature. Ways to minimize this problem are given. No digestive disturbances of consequence occurred and bloat was a minor problem. Studies of carcasses indicated that chicken litter ration had no different effects on ruminant carcasses than any other rations of similar chemical composition. (Penrod-East Central)

### 3009 - A10, B3, C3, D3
### FACTORS AFFECTING DEGRADATION OF POULTRY MANURE BY FLIES,

The Connecticut Agricultural Experiment Station, New Haven
R. L. Beard and D. C. Sands
Environmental Entomology, Vol. 2, No. 5, 1973, p. 801-806.

Descriptors: Degradation, Aerobic conditions, Anaerobic conditions, Microorganisms, Bacteria, Fungi, Yeasts.
Identifiers: Poultry manure, Flies, Waste management, Egg maturation, Larval development.

Studies were conducted to determine interrelating and interacting factors of manure as a culture medium for flies, as well as fly characteristics that favor development in and degradation of manure. In studying the adaptability of flies to poultry manure, it was determined that flies could not be used to biodegrade the already stored bulk of manure in commercial plants without aerating or modifying the manure. The only fly that consistently showed the kind of adaptability to poultry manure that was required for managed degradation was the housefly (Musca domestica L.) The study of poultry manure revealed that flies discriminate against manure only if a more attractive oviposition medium is available. Fresh manure constitutes the best manure medium. As manure was biodegraded, metabolic activity of contained organisms increased to a plateau, ammonia was produced, nitrogen was lost, and pH increased. Bacteria, rather than fungi and yeasts, were primarily responsible for these changes, but metabolism of bacteria and developing maggots interacted. Some bacteria, such as Mima polymorpha, retarded fly development. The conditions necessary for the degradation of manure by flies were found to be aeration (augmented by ventilation), desired moisture gradient in the medium, and favorable temperatures for flies and bacteria. (Penrod-East Central)

### 3010 - B1, C3, D3, E4, F1
### BIOENGINEERING ASPECTS OF ANAEROBIC DIGESTION OF PIGGERY WASTES,

The Scottish Farm Buildings Investigation Unit, Craibstone, Bucksburn, Aberdeen, Scotland
A. M. Robertson, G. A. Burnett, P. N. Hobson, S. Bousfield, and R. Summers
Unpublished paper, 16 p. 3 fig, 4 tab, 4 ref.

Descriptors: Anaerobic digestion, Byproducts, Methane, Fertilizers, Economics.
Identifiers: Swine, Detention time.

A large problem in the animal productions system over the last decade has been the disposal of animal waste. Many studies have been centered around aerobic methods of disposal, but these will not handle pig wastes. Anaerobic digesters have been found to reduce pig solid particulates while retaining essential nutrients of pig waste. Digesters can give optimum reductions of: 40 percent total solids, 90 percent volatile fatty acids, 90 percent $BOD_5$ and 40 percent COD. At digester detention times of 30, 20, and 15 days and at solid input rates of 5 percent, the quality of the gas was found insufficient to maintain the required temperature for the digester in North-east Scotland (where this study was made). However, increasing input solid levels and reducing retention times increases gas production. Also, less gas is required in a warmer climate. The cost of installing a digester of 45 $m^3$ capacity, together with ancillary equipment would be approximately 10,000 pounds. Writing off the equipment over ten years and charging interest on half the capital would give an annual cost of 1 pound, [illegible]0 pence per pig: At a ten day retention time, running costs would amount to 1 pound, 35 pence per pig place per year, based on the running cost of the existing digester, giving a total annual cost of 3 pounds and 25 pence per pig. The value of the surplus gas is estimated at 1 pound. 97 pence per pig and fertilizer recovered from the effluent would have a value of 1 pound. 31 pence per pig. This would bring the value of the digester output to 3 pounds. 28 pence per pig, making anaerobic digestion feasible on a large scale basis. (Cannon-East Central)

### 3011 - A11, B3, C2, E3
### INITIAL RATION SEEN AFFECTING CATTLE WASTE REFEED VALUE,

Feedstuffs, Vol. 48, No. 18, p. 4, May 3, 1976.

Descriptors: Diets, Performance, Nitrogen, Potassium, Phosphorus, Manganese, Nutrients.
Identifiers: Refeeding, Crude fiber, Crude protein.

Scientists from the U. S. Department of Agriculture's Agricultural Research Service and from the University of Nebraska conducted a study to determine if the initial ration affects the cattle waste refeed value. Although supplemental manganese may be needed, feces and manure from housed cattle on a low-roughage ration generally meet requirements for refeeding as a high-roughage ration. Dr. James R. Ellis, ARS microbiologist stated that the practical limitation on refeeding cattle wastes is the large quantity of digestable dry matter and the high handling costs. The research group found that wastes from outdoor feedlots contain 45-95 percent soil and are not suitable for refeeding because of low feed value. Study results showed that the suitability of excreted materials for refeeding declines as the amount of roughage in the original ration increases. The researchers concluded that the roughage level in the ration influences gross energy, crude fiber, crude protein, nitrogen in all forms, potassium, phosphorus, manganese and other mineral elements in the wastes. (Penrod-East Central)

### 3012 - A11, B1, C2
### INFLUENCE OF DRY MATTER AND NITROGEN INTAKES ON FECAL NITROGEN LOSSES IN CATTLE

Department of Animal Science, Arkansas University, Fayetteville
O. T. Stallcup, G. V. David, and L. Shields
Journal of Dairy Science, Vol. 58, No. 9, p. 1301-1307. 1 fig, 3 tab, 22 ref.

Descriptors: Nitrogen, Diets, Effects, Forages.
Identifiers: Dry matter.

A study was conducted at the University of Arkansas to (1) examine influence of intakes of dry matter and nitrogen of steers fed forage diets on output of fecal nitrogen, (2) estimate excretion of metabolic fecal nitrogen from indirect methods based on extrapolation to zero of fecal nitrogen losses from varying intakes of nitrogen, and (3) measure the relationship of fecal nitrogen to excretion of fecal dry matter. Growing Holstein steers were confined in metabolism stalls in a room at 20 degrees C and 50 percent relative humidity. Thirty-two sorghum silages, 13 corn silages, 9 hays, 8 cereal silages, and 6 lots of sudan and sorghum-sudan hybrid forage were fed to the steers. Each forage was fed to 3 steers for a 14-day preliminary and a 7-day collection period. In a preliminary analysis, correlations were .93 between total fecal nitrogen and dry matter intake, .90 between total fecal nitrogen and total nitrogen intake, and .95 between total fecal nitrogen and total fecal dry matter. However, at high and low nitrogen intake there was evidence of departure from a linear relationship. The authors discuss the relative usefulness of 3 regression analyses to estimate metabolic fecal nitrogen. (Penrod-East Central)

### 3013 - A4, A7, B1, E2, F2
### LIVESTOCK AND POULTRY WASTE DISPOSAL CONTROL,

North Carolina State University Agricultural Extension Service, Raleigh
G. Kriz
Circular 556, North Carolina State University Agricultural Extension Service, February, 1973, 8 p.

Descriptors: Air pollution, Water pollution, North Carolina, Regulation.
Identifiers: Waste management, Land disposal.

Questions on air and water pollution control for livestock and poultry waste are answered in this publication by the North Carolina Agricultural Extension Service. Areas of pollution control covered, include (1) Definitions of pollution and nuisance according to North Carolina Law, (2) Factors which determine how animal wastes become a nuisance or cause pollution, (3) Responsibilities of various state agencies, (4) Regulations—local, state or federal—that apply to animal waste disposal, (5) Services provided by the Board of Water and Air Resources, and (6) Assistance that is provided to animal producers by agencies, conservation services and agricultural departments in pollution control and prevention. Conditions affecting pollution potential of animal wastes, methods of animal waste management and land application rates are discussed. Final questions are answered that examine (1) where responsibility lies in insuring that pollution does not result from an animal operation, (2) methods for avoiding pollution when a production unit continues at the same level and (3) methods for avoiding pollution when a production unit either expands or builds a new facility. (Penrod-East Central)

### 3014 - A8, B1, C2
### INTERACTIONS OF BEEF CATTLE WASTES WITH SOIL,

Soil Scientists, USDA, P.O. Box E, Fort Collins, Colorado
F. A. Norstadt and L. K. Porter
Environmental Biogeochemistry, Vol. 2, Chapter 47, Ann Arbor Science, Ann Arbor, Michigan, p. 763-775, 1976. 4 fig, 7 tab, 8 ref.

Descriptors: Soil profile, Cattle, Feedlots, Sampling, Groundwater.
Identifiers: Manure pack, Soil water tensions, Soil temperature, Soil gases.

A soil core study was conducted at a commercial feedlot in Fort Collins, Colorado in 1972. The soil was a silty-clay loam with a water table varying between 240 and 360 cm, according to season and irrigation scheduling of adjacent cropland. Two metal cylinders or caissons were installed to a depth of 450 cm in a nearly square pen. One was located two meters from the feedbunk concrete apron (area receiving the most animal traffic, urine and feces) and the other in the center, about 30 m away from the bunk caisson (area of less traffic and excretion.) A third caisson was located in a nearby alfalfa field for comparison. The lot was usually stocked at 30 $m^2$ per animal. The caissons monitored five depths (15, 60, 90, 180, and 270 cm) for soil water tensions and soil temperatures and permitted sampling of soil gases and soil solutions. Study results indicated that differences in animal traffic and excretion distribution in the feedlot caused 2 distinct soil regions to develop — one aerobic, and one anaerobic. The former was near the center of the lot, and the latter was along the concrete apron in front of the feedbunk. Essentially the feedlot surface was sealed and little if any water infiltrated and percolated. Soil water tensions were stable during the year in the upper feedlot soil profile as compared to alfalfa field. The composition of soil gases differed markedly among the 3 caisson sites. It was found that the soil and micro-organisms responded with interesting reactions not easily observed in cultivated soils. The authors concluded that a northeastern Colorado feedlot, stocked and managed as reported in the study, does not appear to be a hazard to soil and groundwater. (Penrod-East Central)

### 3015 - A6, B1, D2, F1
### CONTROLLING FEEDLOT SURFACE ODOR EMISSION RATES BY APPLICATION OF COMMERCIAL PRODUCTS,

Agricultural Engineering Department, Oregon State University, Corvallis
J. R. Miner and R. C. Stroh
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4566, 16 p. 19 tab, 4 ref.

Descriptors: Odor, Ammonia, Zeolites.
Identifiers: Odor control, Odor intensity, Ammonia absorption rate, Ammonia evolution rate, Potassium permanganate, Sodium bentonite, "Odor Control Plus", "The Nose Knows", LSS10, Sanzyme.

An attempt was made to identify those measurements which would be useful in evaluating the odor problem and in measuring the effectiveness of abatement techniques. The measurements selected for evaluating surface additives were odor intensity, ammonia absorption rate, and ammonia evolution rate. Nine commercially available products for feedlot odor control were applied to one or more pens, each to determine their effectiveness. These included: potassium permanganate, sodium bentonite, "THE NOSE KNOWS", Agco, "ODOR CONTROL PLUS", zeolites, LSS10, and Sanzyme. The four products that were found to effectively control ammonia release were sodium bentonite, ODOR CONTROL PLUS, and the two zeolites. The cost of the effective materials ranged from $300 to $600 per acre for treatment during the odor production season. (Penrod-East Central)

### 3016 - B3, C2, D3, E3, F1
### DESIGN AND OPERATION OF A DEMONSTRATION UNIT FOR METHANE GENERATION,

Agricultural Engineering Department, Maine University, Orono
A. El-Domiaty Hassan, G. S. Putnam, and N. Smith
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4539, 20 p. 6 fig, 5 tab, 8 ref.

Descriptors: Design, Methane, Anaerobic digestion, Costs.
Identifiers: Research and development.

An investigation of the design and development of a full scale pilot plant for methane generation was conducted at the University of Maine poultry facilities. This study was conducted as part of a larger project conducted by the University of Maine Agricultural Engineering Department. The digester used for the laboratory scale studies consisted of 1-liter flasks and 8-liter bottles. The digester used in the early field studies was an insulated 700 gallon cylindrical steel tank. Results from the laboratory kinetic studies showed that the maximum yield of methane was a result of initial solids concentration in the range of 4.6 to 7.6 percent. The most economical operation was found at the higher end of the range (7.0 to 7.5 percent). Methane production in the digester was stimulated by an added carbon source provided that the source was easily degradable and that the concentration was not too high. Time lag in starting the digester was greatly reduced by using inoculum or seed culture. The authors suggested using a continuously fed system or a batch system where 50 percent or less of the digester volume is emptied at one time. Under the conditions of the laboratory study, the optimum temperature for methane production was 35 ± 2 degrees C (93 ± 3 degrees F). The field studies showed that a methane recovery of 130 to 160 1/kg (2.0 to 2.5 $ft^3$/lb.) dry manure with an average methane content of approximately 56 percent. Hydrogen sulfide and water vapor were present in the gas in amounts sufficient to be very corrosive and might need to be removed for several applications. Unless ground up before entering the digester, feathers were found to present a pump clogging problem. (Penrod-East Central)

### 3017 - B2, C2, D3
### CRYSTALLINE PHOSPHATE PRECIPITATION FROM ANAEROBIC ANIMAL WASTE TREATMENT LAGOON LIQUORS,

Agriculture and Home Economics Experiment Station, Iowa State University, Ames
C. V. Booram, R. J. Smith, and T. E. Hazen
Transactions of the ASAE, Vol. 18, No. 2, p. 340-343, May-June, 1975.

Descriptors: Waste treatment, Lagoons, Anaerobic conditions, Chemical properties, Equipment.
Identifiers: Crystalline phosphate precipitation, Encrustation, Phosphate deposition.

A study of the flushing system at Iowa State University was conducted to determine ways to cope with the problem of crystal deposition and pipe blockages. Considerations were given to: (1) anaerobic lagoon conditions that can cause precipitation, (2) the interaction of chemical components in a simplified waste management system, (3) changes in concentration of the component ions $Mg^{++}$, $NH_{4\,+}$, and P in the lagoon, and (4) practical solutions that will allow anaerobic liquid to be pumped with a minimum of difficulty. Equipment utilization and maintenance are also described. Study conclusions included the following: (1) The liquor from certain anaerobic waste treatment lagoons may be expected to cause $MgNH_4PO_4$ deposition in metal pumps and plumbing fittings, (2) Solubility calculations for $MgNH_4PO_4$ indicate that only marginal precipitation should be expected because the solution is only mildly supersaturated, (3) Phosphate concentrations in the bottom sludge of an anaerobic lagoon are much higher than those in the liquor, but the concentration in the liquor does not change much from year to year, (4) All plumbing and pumps to be used for flushing with anaerobic lagoon liquor should be constructed of plastics or of synthetic rubber, (5) Some residual $MgNH_4PO_4$ deposition will take place, even in plastic and this should be controlled by using 1:50 (volume basis) acetic acid solution as a periodic cleaning agent. (6) Relatively speaking, irrigation equipment used to apply anaerobic lagoon effluent to land will pass far less liquid each year than the recycle equipment; hence, encrustation is less of a problem. (Penrod-East Central)

## 3018 - B2
## DESIGNING AN OPEN CHANNEL FOR TRANSPORT OF WASTE,

Agricultural Engineering Department, Purdue University, West Lafayette, Indiana
J. C. Nye and D. D. Jones
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975. 1 fig, 7 tab, 7 ref.

Descriptors: Design, Mathematical models, Slope, Modification, Velocity.
Identifiers: Waste transport, Flushing, Discharge, Volume.

Design principles for transporting waste through an open channel are presented. Study objectives were: (1) to develop a mathematical model that would predict the ability of flush water to transport manure as it flows down an open channel, (2) to determine from this model the length of gutter that could be flushed with a given volume of discharge, duration of discharge, initial velocity and gutter slope. In order to accomplish these objectives, a computer program was developed. Input variables for the program were (1) volume of discharge: 100 to 500 gallons (.38 to 1.9 $m^3$), (2) duration of discharge; 10 to 30 seconds, (3) slope of channel; .005 to .02 ft/ft/or m/m and (4) initial velocity of water in channel; 2 to 3 fps (36.5 to 54.8 m/min.). The Manning "n" roughness coefficient was 0.02. Although verification of the model has not been completed, the following conclusions can be made: (1) For channels longer than 100 ft, a higher velocity and longer duration of flush should be used. (2) Flushing gutter systems can be designed for older buildings using a .005 ft/ft slope if the depth of flow is between 3 and 4 inches and the length of gutter is less than 80 ft. (3) For extremely long gutters over 200 feet, variable slopes or tapered gutters should be used. Further comparisons with existing gutter flushing facilities should produce a computer program that can design more efficient flushing gutter systems. (Penrod-East Central)

## 3019 - A6, B2, D1, D3, F1
## CHEAP EFFECTIVE CURE FOR A SMELLY LAGOON,

Missouri University
B. George
Beef, Vol. 12, No. 8, p. 28-29, April, 1976. 1 fig.

Descriptors: Lagoons, Design, Aeration, Odor, Costs.

To cure a smelly lagoon, Bob George, University of Missouri agricultural engineer, reported on a last resort aeration system that is cheap to build and inexpensive to operate. Mr. George built a giant cross over the lagoon using two-inch pipe. For a lagoon diameter of 100 feet, he used about a 60-foot length of pipe in each direction. A four-way connector at the center hooked the pipes together. Caps sealed off three of the pipes and the remaining end was hooked to a one-half horse power pump which delivered up to 30 psi of pressure. Quarter inch holes were spaced along the length of each pipe, reducing the pressure to 14 psi. The pump mixed lagoon water with oxygen and forced the water and oxygen mixture through the pipes and to the lagoon surface. The aerobic layer that this produced at the top of the lagoon sealed off odors. The cost of construction for a 300 head-hog lagoon was approximately \$250.00-\$300.00 and operated for \$7.00-\$8.00 per month. Bob George stated that it took just 5 days to eliminate odor from the lagoon. Mr. George suggested that his apparatus be used for other types of feetlot lagoons as well. (Penrod-East Central)

## 3020 - A1, A4, A8, A9, B2, B3, B4, C2, D1, D2, D3, E1, E2, F2, F4
## AGRICULTURAL WASTE MANAGEMENT FIELD MANUAL,

U. S. Soil Conservation Service
Agricultural Waste Management Field Manual, U. S. Department of Agriculture, Soil Conservation Service, August, 1975, 345 p. 63 fig, 55 tab.

Descriptors: Agriculture, Legal aspects, Regulation, Water pollution, Air pollution, Water quality, Waste water treatment, Solid wastes, Agricultural runoff, Chemical properties, Livestock, Poultry, Crop response, Geology, Fish, Liquid wastes, Solid wastes, Lagoons, Waste treatment, Waste storage, Waste disposal, Food processing wastes, Pesticides, Equipment, Monitoring, Sampling.
Identifiers: Waste management, Land disposal.

This manual presents information, data, and guidelines for planning, designing, and operating agricultural waste management systems. It is intended for use by field offices of the U. S. Soil Conservation Service (SCS). It supplements but does not supersede national or state standards, specifications, or requirements of SCS as they pertain to various conservation practices. Topics considered are: (1) Laws, rules, and regulations, (2) Water quality, (3) Municipal waste water treatment, (4) Waste characteristics, (5) The role of soils in waste management, (6) The role of plants in waste management, (7) Geologic considerations in waste management, (8) Fish and wildlife aspects of waste management, (9) Livestock and poultry waste management systems, (10) Food processing waste management systems, (11) Land application of wastes, (12) Waste management system components, (14) Pesticides and other chemicals, (15) Waste management equipment, (16) Monitoring and Sampling. Conversion factors and tables are also supplied along with a glossary of terms. (Merryman-East Central)

## 3021 - A5, A8, B2, C2, D3, E2, E3
## MANURE MANAGEMENT IN A 700-HEAD SWINE FINISHING UNIT IN THE AMERICAN MIDWEST: AN INTEGRATED SYSTEM INCORPORATING HYDRAULIC MANURE TRANSPORT WITH RECYCLED ANAEROBIC LAGOON LIQUOR AND FINAL EFFLUENT USE BY CORN (ZEA MAYS),

Department of Agricultural Engineering, Iowa State University, Ames
C. V. Booram and R. J. Smith
Water Research, Vol. 8, No. 12, p. 1089-1097, 1974.

Descriptors: Lagoons, Anaerobic conditions, Irrigation, Nitrates, Groundwater pollution, Hydraulic systems.
Identifiers: Land disposal, Crop response.

In recent years livestock production has shifted from pasturing to intensive confinement, resulting in manure management problems. In the midwestern states, anaerobic lagooning has been tested as a management method, with use of renovated waste water for hydraulic transport. Such lagoons convert mixtures of mucal, granular and fibrous solids in manure into a liquid suspension capable of being pumped, with simple, low capacity equipment. However, lagoon liquor has proven to be far too potent to discharge into a watercourse. One solution has been to employ standard irrigation equipment to discharge excess lagoon liquor to croplands. When anaerobic lagooning was first introduced, it was thought that periodic sludge removal would be necessary. However, three sludge removal surveys in a 10 year period have failed to produce evidence that such sludge accumulation occurs. Problems associated with land application of lagoon liquor have been largely due to nitrates. It has been found that annual applications of less than 280 kg N $ha^{-1}$ can be made on corn with little danger of groundwater pollution and minimal effects on plant tissue. Because anaerobic lagoons are sources of odor, they should be located at least 1 km from residences. Because these lagoons are temperature dependent, they are not recommended for cold climates. Anaerobic lagoons should be as deep as local conditions allow. usually 3-9 m. A loading rate of about 0.08 kg VS $m^{-3}$ $day^{-1}$ is recommended. Purple sulphur-fixing bacteria control $H_2S$ odors and should be encouraged by seeding from other active lagoons. (Penrod-East Central)

## 3022 - A1, B1, E3, F1, F3, F4, F5
## BENEFICIAL USE OF WASTE HEAT FOR AGRICULTURAL APPLICATIONS.

Department of Soil Science Oregon State University Corvallis
L. Boersma
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-3540, 29 p. 4 fig, 9 tab, 36 ref.

Descriptors: Energy, Agriculture, Recycling, Electricity, Irrigation.
Identifiers: Waste heat, Land availability, Waste management, Warm water use, Single cell protein, Protein extraction, Food processing, Aquaculture, Greenhouses, Open field soil warming.

The development of beneficial uses for power plant waste heat is a hard task that needs to be approached with adequate justification. On this basis, the author discusses the justifications for agricultural applications of waste heat and the concepts of proposed applications. The growth of the gross national product during this century has roughly been paralleled by the growth in total energy consumption. An increase in population and the resulting affluence has stimulated the need for increased agricultural production. Increased food production requires large energy inputs. A recent Farm Electrification Council publication estimates that food related activities consume a little over 11 percent of the total energy consumption. The author states that the potential problems of energy shortage, lack of arable land, and water shortage can in part be solved through the development of an integrated production system where resources are recycled. Waste products must become raw materials. Potential contributions to the integrated system of food and fiber production can be evaluated from the standpoint of food production problems, the efficient use of energy and the problems of waste management. Specific applications that are described include single cell protein production, protein extraction, food processing, aquaculture, greenhouses and open field soil warming. (Penrod-East Central)

### 3023 - A11, B3, C2, E3, F1 F2
### EXPERTS VIEW USE OF POULTRY WASTES IN ANIMAL FEEDING, SAVINGS, LEGAL ASPECTS,
Feedstuffs, Vol. 48, No. 13, March 29, 1976, p. 25-27.

Descriptors: Costs, Economics, Performance, Nutrients, Legal aspects, Proteins, Nitrogen, Calcium, Phosphorus.
Identifiers: Refeeding, Dried poultry wastes.

To update feed companies on animal waste refeeding issues, the Agricultural Waste Processors Association recently invited some experts in the field of waste recycling to define the usefulness of poultry waste and to address the problem of emotional opposition to feeding animal wastes. Among those presenting data were John Bergdoll, general manager, Bunnett-Smallwood and Company, Indianapolis, Indiana; Dr. W. Bolton, head of the nutrition section, Agricultural Research Council's Poultry Research Center, Edinburgh, Scotland, and Dr. Robert Blair, formerly of the Poultry Research Center, and now with Swift Canadian Company, Ltd. Topics considered by these men included: the newer applications of poultry wastes in animal feeding, experiences with feeding levels of the waste material, and legal considerations. DPW was found to be a source of protein, calcium, phosphorus, trace minerals, and nitrogen. While DPW was found to be a variable product, some factors causing this variability are controllable. Bolton found that properly sterilized DPW did not present a disease hazard, but he urged that DPW should come only from birds not fed diets containing drugs or growth stimulants. DPW was effectively fed as a feed supplement for broilers, rearers, layers, and pullets. DPW was found to be an even more effective food supplement for ruminants because ruminants can utilize the non-protein nitrogen. In the poultry industry, Blair took the low figure of $2/ton as the potential savings and projected a total savings throughout the industry as being about $5.8 million annually. Taking as the low figure throughout the ruminant industry, $4/ton as the potential savings, he projected an annual savings of about $12 million. Alan Ashby, general secretary of Agricultural Waste Processors Association, London, asserted that laws may be needed to enforce the use of wastes in feeds to overcome the emotional ignorance toward such feed stuff and thereby release grains for human consumption. (Penrod-East Central)

### 3024 - A8, B2, B3, C2, E2
### DAIRY MANURE UTILIZATION AND FIELD APPLICATION RATES,
Area Soil and Water Specialist, Parlier, California
J. L. Meyer, R. S. Rauschkolb and E. Olson
Unpublished paper, 14 p. 3 fig, 3 tab, 9 ref.

Descriptors: Salts, Nitrogen, Crop response, Nutrients, Liquid wastes, Solid wastes, Soil profile, Leaching, Denitrification.
Identifiers: Dairy manure, Volatilization.

Alarm concerning nutrient and other salt movement in soils and their possible entry into water supplies has caused researchers to examine dairy manure management practices. It has been found that in storing solid wastes, deep percolation losses of nutrients and salts can be prevented by not disturbing the bottom of the pack. Also, liquid waste storage ponds have been found to be self-sealing. Both liquid and solid dairy wastes have been found to be beneficial when applied to crops. The key to conserving nitrogen applied to the croplands is to incorporate it into the soil as soon as possible in order to prevent denitrification or leaching. Factors affecting nitrogen availability and conservation include: amount of nitrogen released for plant use, method of application, handling, storage between collection and use and rate of application. Excessive nitrogen from organic or inorganic sources may be leached to the water table. Improved manure management with less nitrogen loss will mean fewer total salts added to the soil, since less manure will be needed to meet the nitrogen requirements of crops. (Penrod-East Central)

### 3025 - B2, D3, E4
### FERMENTATION OF FEEDLOT WASTE FILTRATE BY FUNGI AND STREPTOMYCETES,
Northern Regional Research Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Peoria, Illinois
B. A. Weiner and R. A. Rhodes
Applied Microbiology, Vol. 28, No. 5, p. 845-850, 1974 6 tab, 15 ref.

Descriptors: Fermentation, Waste treatment, Byproducts, Feeds, Fungi, Nitrogen, Glucose, Carbohydrates, Liquid wastes.
Identifiers: Streptomycetes, Filtrates, Dairy Whey.

The soluble and dispersed carbon and nitrogen components in cattle feedlot waste filtrates provide a nutrient source from which single-cell protein could be produced for animal feeds. A study was conducted to find dilamentous organisms that could reduce pollutants and filter easily for cell recovery. More than 200 fungi and streptomycetes were studied for their ability to use nitrogen and organic material in the waste, the latter being measured by chemical oxygen demand. The production of cell mass and the effect of adding glucose and dairy whey to waste filtrates also were investigated. Only 20 percent of the organisms were able to grow appreciably in the filtrate. Of these, it was found that dry-weight yields varied from 0.6 to 2.7 grams of mycelium per liter. From 21 to 50 percent of the nitrogen in the filtrates was used during growth. Chemical oxygen demand levels diminished from 4 to 60 percent. Streptomycetes isolated from the feedlot used filtrate nutrients better than fungi did. Addition of glucose or whey increased cell yields of selected organisms by as many as six times; nitrogen was better utilized; and chemical oxygen demand varied from 0 to 33 percent in increase. (Penrod-East Central)

### 3026 - A11, B2, C2, D3, E3, F3, F5
### FEEDING VALUE OF ANIMAL WASTE NUTRIENTS FROM A CATTLE CONFINEMENT OXIDATION DITCH SYSTEM,
Department of Animal Science, Iowa State University, Ames
R. L. Vetter, R. D. Christensen, G. Frankl, and W. R. March
A. S. Leaflet R170, Iowa State University Cooperative Extension Service, Ames, July, 1972, 7 p. 5 tab.

Descriptors: Nutrients, Feeds, Liquid wastes.
Identifiers: Refeeding, Oxidation ditch, Animal health, Meat quality.

Effluent from an oxidation ditch system was studied to determine the nutritional value of the waste nutrients and to evaluate any effects of refeeding on animal health and meat quality. The same control ration was fed in all three tests with adjustments made in the dry supplement in tests 2 and 3 for protein, calcium and phosphorus contained in the animal waste nutrient feed. The experimental ration was made by directly pumping liquid animal waste material from the oxidation ditch into a mixing wagon which contained the adjusted control ration, thoroughly mixing it, and then augering it into the feed bunk. This feed mixture was prepared and fed on a twice daily basis. Results indicated that animal waste biologically processed through the oxidation ditch system has an acceptable nutritional value and can be used effectively as a partial protein and mineral supplement. No animal health or meat quality problems occurred. Extensive research data are still needed to adequately evaluate the system as an approved feeding concept. Other feeding outlets or methods of concentrating the effluent material are needed if feeding is the desired procedure for utilizing all the animal waste production. (Penrod-East Central)

### 3027 - B1, C3, D3, E3, F1
### GENERATING METHANE GAS FROM MANURE,
Department of Agricultural Engineering, College of Agriculture, Missouri University, Columbia
C. Fulhage, D. Sievers, and J. R. Fischer
Science and Technology Guide, Columbia Extension Division, University of Missouri, 1975, 4 p. 2 fig, 3 tab.

Descriptors: Methane, Recycling, Anaerobic digestion, Design, Equipment, Energy, Management, Costs.

This paper provides quantitative information for evaluating the feasibility of methane generation in specific situations. There are many factors that determine how much methane may be obtained. These include: (1) gas yield, cu. ft. per lb. volatile solids destroyed, (2) volatile solids voided, (3) percent reduction of volatile solids, (4) potential gas production per animal, (5) energy production rate, and (6) available energy BTU/hr after heating digester. An anaerobic digester's design volume is based on the amount of volatile solids that must be treated daily and detention time. The equipment necessary to generate usable quantities of methane from an anaerobic digester is complex and requires a substantial investment. The main structure is a digestion tank, usually cylindrical in shape to promote better mixing. Digester loading must be regular to insure a continuous supply of food for the anaerobic bacteria. Maintenance of correct loading rates and detention times and the facilitation of mixing and pumping require a manure slurry of the proper solids content. System imbalance may be caused by (a) loading rate, (b) temperature, and (c) nature of the waste. The addition of toxic materials such as antibiotics can also cause imbalance. Once an imbalance is discovered, pH control should be maintained until the cause of the upset is discovered. The gas produced can either be burned for energy right away or it can be stored. The advantages and disadvantages of each are discussed. High investments in money and management along with difficulties in efficiently using methane make anaerobic digestion a questionable venture for most farmers. Research is needed to reduce capital costs of methane generation systems and provide techniques for proper management of such systems. (Penrod-East Central)

### 3028 - A6, B2, B3, B4, D2, F1
### EVALUATION OF ALTERNATIVE APPROACHES TO CONTROL OF ODORS FROM ANIMAL FEEDLOTS,
3131 N. W. Norwood Place, Corvallis, Oregon
J. R. Miner
Project Report, National Science Foundation Program of Research Applied to National Needs, Grant Number ESR74-23211, December, 1975, 83 p. 5 fig, 53 tab, 8 ref.

Descriptors: Odor, Feedlots, Cattle, Agricultural runoff, Waste storage, Chemical treatment, Economics, Idaho.
Identifiers: Odor control, Green belt barrier, Sodium bentonite, ODOR CONTROL PLUS, Zeolites, Potassium permanganate.

Alternate techniques for control of odors from a cattle feedlot were evaluated at a southeastern Idaho site. The odor sources studied were the feedlot surface and the runoff collection and storage ponds. Nine products were applied to the various feedlot pen surfaces at rates and frequencies suggested by the manufacturers. Ammonia release rates and odor intensities of the feedlot litter were measured. Sodium bentonite, ODOR CONTROL PLUS, and two neutral zeolites were found to consistently reduce the rate of ammonia release from the treated area. The cost of the effective materials ranged from $300 to $600 per acre for treatment during the odor production season. Two materials were added to the feed ration as potential odor control techniques. Neither material proved effective based upon the ammonia release rate or the odor intensity measurements made. A green belt odor barrier was established along the two sides of the feedlot where odor control is essential. Three species of trees and shrubs were planted. The success of this procedure cannot be measured until the plantings mature. A spray system was installed in the same area as the plantings to create a mist extending 20 ft into the air along these borders. This system is effective only under low wind velocities which is also the time of greatest odor transport. The spray system was also used to spray a dilute potassium permanganate solution. When applied at concentrations below 74 mg /1, no plant effects were noted. When added to the spray at 10 mg /1, potassium permanganate seemed to further speed the odor intensity reduction with distance. Two chemicals were sprayed on the runoff retention ponds as on odor control effort, but certain factors made evaluation difficult. Further experimentation is necessary. Examination of the climatic data indicate that for the Blackfoot, Idaho area, climatic conditions would transport odor from the Harding Feedlot toward the Moreland community approximately three percent of the time. (Miner-Oregon; abstract edited by Merryman)

### 3029 - A4, B1, F3, F6

### INVESTIGATION OF REMOTE SENSING TECHNIQUES FOR AGRICULTURAL FEEDLOT POLLUTION DETECTION,

Remote Sensing Institute, South Dakota State University, Brookings
F. A. Schmer, D. W. Ryland and F. A. Waltz
Project Completion Report SDSU-RSI-72-14, Remote Sensing Institute, South Dakota State University, April, 1973, 166 p. 37 fig, 9 tab, 14 ref.

Descriptors: Research and development.
Identifiers: Remote sensing techniques, Feedlot pollution, Water quality analysis, Thermal imagery analysis, Visual analysis.

This research effort was directed toward the application of remote sensing techniques to the detection and monitoring of pollution from cattle feeding operations. Five livestock feeding operations were selected for the study along the James River from Huron to Redfield, South Dakota. Thirteen aerial missions were flown from January 1, 1971 through June 30, 1972, providing aerial photography and thermal infrared data under various weather conditions. Water samples were collected during nine of the aerial flights at fourteen river locations. Water samples were collected a minimum of every three weeks on a regular schedule to allow independent analysis of the water quality data. Data analysis consisted of visual interpretation of aerial photography and statistical analysis of film densities and water quality parameters. Analysis of variance and linear regression techniques were also utilized. In addition, an attempt was made to adjust the film densities for variations in incoming radiation. Results indicated that remote sensing techniques utilizing low and high altitude aircraft photography can be used to locate potential feedlot pollution sources. The statistical analysis showed good results for specific aerial missions but considerable variability was noted between aerial flights indicating that additional study is warranted. (Schmer, et. al.-South Dakota State University)

### 3030 - A5, A11, A13, C2, D3, F1, F3

### THE USE OF AEROBIC PROCESSES FOR THE STABILIZATION OF ANIMAL WASTES,

School of Agriculture, The North of Scotland College of Agriculture
K. Robinson
CRC Critical Reviews in Environmental Control, Vol. 4, No. 2, p. 193-220, July, 1974. 4 fig, 130 ref.

Descriptors: Aerobic treatment, Nitrogen, Economics.
Identifiers: Oxidation ditch, Waste stabilization.

Aerobic treatment is presented as any process which attempts to improve oxygen supply to aerobic microorganisms responsible for converting waste into a relatively biologically stable product. The concentrated effort which has gone into the study of animal wastes and oxidation ditches is recognized. A major problem of oxidation ditch systems has been an inability to relate the waste's oxygen demand to the system's oxygen supply and to the activity of the microorganisms. An understanding of the relationship of degradation rate to rate of microbial activity should eliminate the problems of foaming and oxygen depletion. Nitrogen transformation is emerging as a very important fundamental aspect of aerobic treatment. Much more needs to be done on the factors influencing the growth and activity of the microorganisms involved in the transformation processes so that operation parameters can be established which will specify modes of operation for maximum nitrogen retention, as ammonia, nitrite, or nitrate, or maximum nitrogen removal. The only true costing of treatment is one obtained under commercial conditions. Demand for composting processes for solid wastes has been limited; therefore, research effort has also been limited. The following are recommended for future investigation: (1) development of alternative methods for measuring oxygen demand of agricultural wastes, (2) a detailed assessment of the treatability of wastes, (3) development and use of alternative aeration devices, (4) in-depth study of treatment under limited oxygen conditions, (5) determination of fundamental factors controlling nitrification-denitrification processes, (6) feasibility study of methods which will relate loading to microbial activity, (7) study of solids separation, (8) attention to the design and operation of simple aerobic treatment systems, (9) detailed study of aerobic composting processes, (10) consideration of modification of aerobic waste treatment processes to maximize final utilization of waste on land or as feedstuff. (Penrod-East Central)

### 3031 - A8, B2, C2, E2, F1

### SLURRY IS VALUABLE,

Agricultural and Food Chemistry Research Division
S. N. Adams
Agriculture in Northern Ireland, Vol. 48, No. 11, p. 387, 1973.

Descriptors: Slurries, Economics, Nitrogen, Phosphate, Potash.
Identifiers: Land application.

Farmers should regard slurry not as a "problem", but as a valuable source of expensive fertiliser nutrients. Slurry is a valuable organic manure which provides nitrogen, phosphate and potash for grass and crops. The following fertiliser nutrients are produced each year in excreta of housed livestock: (a) One dairy cow (housed 6 months) produces 90 lbs of nitrogen, 35 lbs of phosphate, and 90 lbs of potash. (b) One pig produces 25 lbs of nitrogen, 20 lbs phosphate, and 20 lbs of potash. (c) One hundred broilers produce 55 lbs of nitrogen, 55 lbs of phosphate, and 30 lbs of potash. (d) One hundred laying hens produce 120 lbs of nitrogen, 120 lbs of phosphate, and 50 lbs of potash. Phosphate and potash in slurry are less quick acting than in fertiliser, but this does not matter for grassland. Monetary value of the nutrients available from the above-mentioned livestock slurries is given in terms of pounds. (Merryman-East Central)

### 3032 - A1, B5, E2

### THE DECOMPOSITION OF CATTLE DUNG AND ITS EFFECT ON PASTURE,

The Hannah Research Institute, Ayr
M. E. Castle and E. MacDaid
Journal of the British Grassland Society, Vol. 27, p. 133-137, 1972. 9 ref.

Descriptors: Cattle, Pastures, Dairy industry, Crop response.
Identifiers: Decomposition, Dung, Herbage, Swards.

To investigate the effect of the intensity of grass-land management on the rate of decomposition of dung, and on the area of herbage rejected, a study was made in which swards received either a high or a low rate of fertilizer N and were then grazed by dairy cows. In early spring, 1967, four plots with swards of a similar botanical composition were fenced and fertilizer treatments were imposed throughout 1967 and 1968. N was applied as nitro-chalk (21 percent N) at approximately monthly intervals, beginning in April, 1967 and May, 1968. A total of 228 separate dung pats voided by lactating dairy cows between May and October on a ryegrass /clover swards were studied for 2 years. The pats were on grazed swards receiving, on average, either 440 or 110 lb N /ac (492 or 123 kg /ha) per year. The mean output of the plots was 520, 440, 280 and 310 cow grazing-days /ac per year, respectively. The plots receiving the highest weight of fertilizer N clearly gave the highest number of grazing-days /ac, exerted on that treatment. The mean area of the dung pats was 0 • 62 + 0 • 18 ft$^2$. On average, the pats on the high- and low-N treatments crumbled in 63 and 55 days, respectively, and disappeared in 115 and 113 days, respectively. The average area of rejected herbage around the pats was 2.63 and 0 • 84 ft$^2$ respectively, 1-2 months, and 1 year after they were voided. In conclusion, it was found that the level of fertilizer N applied to the grazing sward had no direct effect on the rate of breakdown of the dung. (Cameron-East Central)

### 3033 - A8, A11, B2, C2, E2

### EFFECTS OF COW SLURRY ON HERBAGE PRODUCTION, INTAKE BY CATTLE AND GRAZING BEHAVIOR,

National Institute for Research in Dairying,Shunfield, Reading, Berkshire
B. F. Pain and J. D. Leaver
Journal of the British Grassland Society, Vol. 29, p. 85-91, 1974. 1 fig, 5 tab, 9 ref.

Descriptors: Slurries, Cattle, Animal behavior, Crop response, Grazing, Nutrients.
Identifiers: Land disposal, Herbage production.

Experiments were done to compare the effect of different levels of slurry application on herbage production and on intake by grazing heifers. Grassland plots received different amounts of cow slurry in January or March and were grazed by dairy heifers at intervals from late April to August. In the first experiment (which had slurry level applications up to 56 tons /ha) there was a clear response of herbage DM production to the amount of slurry applied. Even though the plots received the same amounts of inorganic N, the total herbage DM produced on the 36.8 and 56.6 t /ha slurry treatments was 60-70 percent greater than the control. In the second experiment, although slurry levels as high as 100 tons /ha were used, the herbage DM production was very similar on slurry treatments and on controls to the results in the first experiment. No significant differences were found in herbage production on the plots spread with slurry in January or in March. The percentage of nutrients in the slurries used in the two years was very similar, except for K levels, which were higher in 1971. The levels of N, P and K in herbage for both experiments were only slightly increased after slurry treatment. There was evidence from behaviour observations that the animals were better able to detect the slurry, or its effects, in the plots dressed at 75 or 100 t /ha in March. During periods of observation, the heifers were less likely to lie and to ruminate in plots treated with these amounts. It is likely that the effects of slurry application on herbage production, animal intake and grazing behaviour recorded in these experiments would be modified by different soil and climatic conditions. (Cameron-East Central)

### 3034 - A8, B2, C2, E2, F3

### THE EFFECT OF HEAVY DRESSINGS OF SLURRY ON FORAGE MAIZE PRODUCTION,

National Institute for Research in Dairying, Shinfield, Reading, Berks
B. F. Pain and R. H. Phipps
Journal of the British Grassland Society, Vol. 29, p. 263-267, 1974. 8 tab, 11 ref.

Descriptors: Slurries, Crop response, Potassium, Nitrates, Magnesium.
Identifiers; Land disposal, Application rates.

A study was conducted to investigate the effects on the quality and quantity of forage maize produced when heavy dressings of cow slurry were incorporated into the soil shortly before drilling the seed.

Sandy loam soil overlying valley gravel formed the experimental site. Slurry of 15 percent dairy manure was dressed on the soil in amounts of 0, 125, 250 or 500 tons per half acre and then ploughed to a depth of 15 cm. The slurry plots were in randomized blocks, replicated 3 times. The control plots, which received only inorganic fertilizer, were offset to avoid contamination. All plots were sown with maize. Quantity and quality determinations were made 73, 93, 115, and 137 days after plant emergence. It was found that the slurry dressings delayed the emergence of maize plants. While the 250 tons per half acre treatment gave significant increase in yield at final harvest, 500 tons per half acre depressed yields of the whole crop and of the ear. Slurry applications increased the level of K and nitrate-N in the plants, but depressed Mg. Crude protein and invitro digestibility were not affected. In view of the high levels of nitrate-N encountered and evidence of K/Mg imbalance, further work would be required to assess the status of maize grown under these conditions as a livestock feed. (Penrod-East Central)

### 3035 - A10, F6
### COMPARISONS OF HORN FLY DEVELOPMENT IN MANURE OF FIVE ANIMAL SPECIES,

Department of Entomology and Nematology, Florida University, Gainesville
N. I. Greer and J. F. Butler
Florida Entomologist, Vol. 56, No. 3, p. 197-199. 1973. 1 tab, 3 ref.

Descriptors: Farm wastes, Livestock, Cattle, Larvae.
Identifiers: Fly breeding, Horn flies, Feces, Horses, Sheep, Bison, Swine, Pupae.

Laboratory and field studies were conducted to determine if horse, bison, sheep, and swine manure could serve as a medium for rearing horn fly larval stages to viable adults. The standard larval medium, a modification of the Kerrville rearing medium, consisted of a dry mix (246 g sugar cane pulp, 48 g wheat flour, 36 g fish meal, 6 g sodium bicarbonate, 29 g alfalfa meal), cattle manure, and distilled water mixed in a ratio of 2:3:5 by weight. Larvae were maintained at 25 degrees C and 60-70 percent RH. Adults were maintained at 32 degrees C and 70-80 percent RH. Field observations of female horn flies ovipositing on fresh horse and cattle manure were made. The horn fly populations on cattle and horses were counted. Analysis of variance was used to determine significant differences in development on the larval media. Results showed that pupal survival in cattle manure was 31 percent. Horn flies developed to the pupal stage in feces of bison, sheep, horse, and the standard laboratory medium. Significantly more adults were reared from feces of sheep, bison, horse, cattle, and laboratory media than from swine feces. No larvae developed to pupae in swine manure. Data on the percent eclosion showed that bison, sheep, and horse manure were excellent media for development. The adults reared from the laboratory medium, and cattle, sheep, horse, and bison feces produced viable eggs. No significant differences in fly larval development among manure of cattle, sheep, bison, and horse, and laboratory medium was demonstrated. Data indicated that horn flies in the laboratory can complete their larval life in the manure of bison, sheep or horse in addition to cattle manure. In field observations, adult horn flies were found in low numbers on sheep, horse, and bison. (Cameron-East Central)

### 3036 - A1, B1, D1
### CATTLE MARKET WASTES,

J. M. Sidwick, F. D. Watson, and D. M. Watson
Water and Pollution Control, Vol. 71, No. 4, p. 533-539, 1972.

Descriptors: Waste treatment, Waste water treatment, Sampling.
Identifiers: Cattle market wastes.

The author comments that the extremely varied and seasonal nature of cattle market wastes, combined with the fact that the markets are usually located in small towns with limited ability to handle large amounts of troublesome wastes, make this form of agricultural waste particularly problematic. He suggests that high-power hoses be used to minimize the amount of water needed to wash out pens and stalls, and that clean water from the market, such as rainwater from roofs, be kept separate from the polluted wash water. All drains should be provided with screens so that straw and other large objects cannot pass into the sewer along with the water. As much of the waste as possible should be cleaned out of the pens in its solid state before any water is added to it. Except for screening, any pretreatment of the waste water prior to its entry into the sewer is not feasible. Once the water reaches the sewage treatment plant, it may create problems, since it is not so biodegradable as municipal sewage, does not produce as much gas, and is highly colored. Suggestions are offered regarding sampling and prediction of quantity and composition of market wastes. An extensive bibliography on management and health aspects of market wastes is included. At the end of the paper there is a short discussion by those present at the reading of the article. (Solid Waste Information Retrieval System)

### 3037 - A11, C2, C3, E3, F2
### FDA GUTS DPW USE,

Anonymous
Egg Industry, Vol. 9, No. 4, p. 28, April, 1976.

Descriptors: Regulations, Legal aspects.
Identifiers: Food and Drug Administration, Dried poultry wastes, Refeeding.

This aspersive attack on the Food and Drug Administration's attitude toward refeeding dried poultry wastes (DPW) charges that within a few months, the Food and Drug Administration will publish its long-awaited waste recycling proposals and that they will be so restrictive that the only animals allowed to be fed DPW will be animals that nobody feeds a supplement to anyway, such as overwintered beef stock or dry cows. The article charges that the reason for this bureaucratic tokenism is that the Bureau of Veterinary Medicine and the Bureau of Foods within FDA cannot agree on the safety of the practice. It is suggested that the poultry associations may have to take the lead in demonstrating to FDA that the practice is safe and that perhaps a suitable monitoring system could be established that could be translated into a national program. Another alternative might be to test FDA's decision in court. (Merryman-East Central)

### 3038 - A6, A8, A10, A11, A12, B1, E2, F1, F2,
### MANURE DISPOSAL, POLLUTION CONTROL, AND THE NEW YORK DAIRY FARMER,

Agricultural Waste and Watershed Researcher, Engineering Research Service, Department of Agriculture, Ottawa, Canada
D. R. Coote and P. J. Zwerman
New York's Food and Life Sciences Bulletin, No. 51, Physical Sciences: Agronomy, No. 3, April, 1975, 19 p. 3 tab. 100 ref.

Descriptors: Dairy industry, Waste disposal, New York, Economics, Regulation.
Identifiers: Land disposal, Pollution control.

Fifty New York dairy farms were visited in 1971 to investigate dairy waste management problems and farmer attitudes toward economic and environmental effects of alternative waste management methods. Two distinct types of dairy farms were noted (1) those with conventional barns (cattle stayed mostly in pasture) and (2) those with freestall barns (cattle permanently confined in barn and exercise yard or pasture). In the pasture system, cattle spread their own manure; in the freestall barn, farmers disposed of the manure. Most farmers felt that all their manure could beneficially be used in field spreading. However, some freestall farmers favored "dumping" of manure on fields, regardless of environmental effects. Existing regulations that limit pollution by dairies are discussed. Other possible legal approaches are: (1) Restrict the manure amounts to be spread on an area in one year, (2) Restrict manure spreading to soils that are not excessively permeable or excessively impermeable, (3) Restrict manure spreading to flat or only gently-sloping fields, (4) Restrict manure spreading to areas greater than some acceptable distance from surface water capable of leaving the operator's property, (5) Restrict the housing of animals and the spreading of manure to areas greater than some acceptable distance from dwellings and public areas, (6) Restrict manure spreading to certain times of the year, (7) Require that a certain minimum land area be zoned and controlled by the farm operator according to the quantity and type of animals kept, (8) Require that any form of manure disposal, other than land application, meet the same controls and standards as those required for industrial or municipal effluent disposal. (9) Require that manure managing be such that no disease, odor, insect, or rodent nuisance is caused. (Penrod-East Central)

### 3039 - A2, A4, B1, F1, F2
### IMPLICATIONS OF EPA PROPOSED REGULATIONS OF NOVEMBER 20, 1975 FOR THE ANIMAL FEEDING INDUSTRIES,

U. S. Department of Agriculture, Animal Waste Subcommittee
Implications of EPA Proposed Regulations of November 20, 1975 for the Animal Feeding Industries, U. S. Department of Agriculture, January 30, 1976. 39 p. 21 tab.

Descriptors: Regulations, Economics, Water pollution, Point sources, Feedlots, Livestock.
Identifiers: National Pollutant Discharge Elimination System, Waste management.

The Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) proposed regulations of November 20, 1975, for livestock operations could require an estimated 94,500 operators to apply for permits. The information contained in this report is based on expert opinion (not surveys) of USDA and State research and extension personnel located in major livestock producing States and was not available when EPA proposed the regulations. Of the estimated 94,500 operations affected by NPDES regulations—manmade waste conveyance, navigable water traversing the operation, and large operations—there are 14,000 beef, 32,000 dairy and 48,500 swine operations. In addition, as estimated 250 turkey range operations would be affected. Estimates indicate that less than 4 percent of the operations that would be affected have capacities of more than 300 animal unit equivalents (300 beef animals, 750 swine and 210 dairy cows). Over 70 percent of the operations judged to be affected had capacities of less than 100 beef animals, 250 swine and 70 dairy cows. In order to comply with the proposed regulations, it is likely that affected operations would have to install systems to control discharges. Additional investments to install these systems would amount to about $205 million. For an additional 10 percent of the operations, the least-cost method of meeting proposed regulations would be to relocate the operation. The estimated 94,500 operations affected account for 20 percent of total fed beef marketings, 19 percent of milk sales, and 11 percent of hogs and pigs marketed. The proposed regulations contain a further provision for identifying a "concentrated animal feeding". This provision allows for "case-by-case" designation of additional operations, regardless of size, that must apply for an NPDES permit, but the factors determining the outcome of these determinations are not listed in the proposed regulations. (Merryman-East Central)

### 3040 - A3, A4, C2
### THE INFLUENCE OF LAND USE ON STREAM NUTRIENT LEVELS,

Eutrophication Survey Branch, Corvallis Environmental Research Laboratory, Crovallis, Oregon
J. M. Omernik
Environmental Protection Agency Report Number EPA-600/3-76-014, January, 1976, 106 p. 29 fig, 8 tab, 31 ref.

Descriptors: Land use, Water quality, Nutrients, Watersheds, Agricultural runoff, Drainage patterns (geologic), Phosphorus, Nitrogen, Concentrations, Eutrophication, Stream flow, Animal unit density, Soils, Eastern U. S.
Identifiers: Non-point source.

National Eutrophication Survey (NES) data for 473 non-point type drainage areas in the eastern United States were studied for relationships between drainage area characteristics (particularly land use) and nutrient levels in streams. Both the total and inorganic forms of phosphorus and nitrogen concentrations and loads in streams were considered. The objectives were to (1) investigate these relationships as they were evidenced by the NES data and (2) develop a means for estimating stream nutrient levels from knowledge of "macro" drainage area characteristics. Mean nutrient levels were considerably higher in streams draining agricultural watersheds than in streams draining forested watersheds. The levels were generally proportional to percentages of land in agriculture, or the combined percentages of agricultural and urban land use. Variations in nutrient loads (exports) in streams, associated with differences in land use categories, were not as pronounced as the variations in nutrient concentrations. This was apparently due, in large part, to differences in areal stream flow from different land use types. Regression and analysis of the combined percentages of agricultural and urban land uses against both the total and inorganic forms of phosphorus were performed. Equations for these analyses, together with maps illustrating the equations residuals offer a limited predictive capability and some accountability for regional characteristics. (Mernik-EPA)

## 3041 - B1, D2, E3, F1
## CATTLE MANURE KEY TO METHANE GAS SUPPLIES,

Western Livestock Journal, Vol. 54, No. 30, p. 5, April 19, 1976.

Descriptors: Recycling, Methane, Fertilizers, Economics.
Identifiers: Cattle manure, Ethane, Ethylene, India.

Cattle manure was viewed by scientists at the American Chemical Society meeting in New York City as a large potential source of methane gas, nitrogen and other fertilizers, and chemical feedstocks. Experiments performed at Texas Tech University, Lubbock, demonstrated that significant yields of ethane and methane, anhydrous ammonia synthesis gas and ethylene could be obtained by processing cattle waste in a partial oxidation (thermal) reactor. It was pointed out that if only one eighth of India's supply of cattle dung were treated in this way, it could result in a seven fold increase in India's critically low fertilizer rate, bridging the gap between projected demand and supply, not only in fertilizer but also in food. (Merryman-East Central)

## 3042 - A2, A4, A5, E2, F4
## LOADING FUNCTIONS FOR ASSESSMENT OF WATER POLLUTION FROM NONPOINT SOURCES,

Midwest Research Institute, 425 Volker Boulevard, Kansas City, Missouri
A. D. McElroy, S. Y. Chiu, J. W. Nebgen, A. Aleti, and F. W. Bennett
Environmental Protection Agency Report No. EPA 600/2-76-151, May, 1976, 444 p. 50 fig, 75 tab.

Descriptors: Water pollution, Non-point sources, Water pollution, Nutrients, Pesticides, Salinity, Irrigation return flow, Heavy metals, Radiation, Livestock, Pollutants, Sediments, Phosphorus, Agricultural runoff, Mining, Soil erosion, Groundwater pollution, Coliforms.
Identifiers: Land disposal, Urban runoff.

Methods for evaluating the quantity of water pollutants generated from nonpoint sources including agriculture, silviculture, construction, mining, runoff from urban areas and rural roads, and terrestrial disposal are developed and compiled for use in water quality planning. The loading functions, plus in some instances emission values, permit calculation of nonpoint source pollutants from available data and information. Natural background was considered to be a source and loading functions were presented to estimate natural or background loads of pollutants. Loading functions /values are presented for average conditions, i.e., annual average loads expressed as metric tons/hectare/year (tons/acre/year). Procedures for estimating seasonal or 30-day maximum and minimum loads are also presented. In addition, a wide variety of required data inputs to loading functions, and delineation of sources of additional information are included in the report. The report also presents an evaluation of limitations and constraints of various methodologies which will enable the user to employ the functions realistically (McElroy-Midwest Research Institute)

## 3043 - A4, A6, A7, F4 300
## ODOR POLLUTION (A BIBLIOGRAPHY WITH ABSTRACTS),

National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia
G. H. Adams and E. Lehmann
National Technical Information Service Publication PS-75/723, September, 1975, 192 p.

Descriptors: Bibliographies, Odor, Air pollution, Farm wastes, Sewage sludge, Industrial wastes, Water pollution.
Identifiers: Rendering plants.

This bibliography contains abstracts of publications concerned with odorous air pollutants and odors and tastes in water. Publications from the years 1964 through September, 1975 are included. Topics covered include agricultural and livestock wastes, sewage sludge, industrial wastes, stack emission, vehicular exhausts, dredge spoil, rendering plants, hospitals, oil spills, and polluted water streams. Treatment methods, environmental protection, and human factors are cited. (Merryman-East Central)

## 3044 - A1, A2, A8, B1, E1, E2, F4
## ANIMAL WASTE POLLUTION AND ITS CONTROL (A BIBLIOGRAPHY WITH ABSTRACTS),

National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia
R. Brown
National Technical Information Service Publication PS-75/531, June, 1975, 122 p.

Descriptors: Fertilizers, Pollution control, Agricultural runoff, Swine, Bibliographies.
Identifiers: Animal wastes, Rendering wastes.

This bibliography contains abstracts of publications concerning pollution and pollution control of animal wastes and animal processing wastes. The articles span the years 1964-May, 1975. Topics covered include feedlot waste pollution and control, pollution from manure used in fertilization, water runoff from farms, dairy and livestock wastes, rendering wastes, poultry processing wastes, ecological aspects, and hoghouse waste control. (Merryman-East Central)

## 3045 - A5, A8, B2, B3, C2, E2
## GROUND WATER POLLUTION. PART 2. POLLUTION FROM IRRIGATION AND FERTILIZATION,

National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia
E. Lehmann
National Technical Information Service Publication PS-75/740, September, 1975, 183 p.

Descriptors: Groundwater pollution, Irrigation, Fertilizers, Sewage, Nitrates, Phosphates, Salts, Groundwater recharge, Bibliographies.
Identifiers: Land spreading.

Selected abstracts are presented of publications that cover all aspects of groundwater pollution from irrigation and fertilization. The publications span the years 1964 to September, 1975. Topics include pollution from sewage and waste water irrigation, land spreading of sludges and solid wastes, nitrate and phosphate accumulation in soils, pollution control and abatement planning, salt build-up from irrigation, the use of tile drains in groundwater pollution control, and groundwater recharge studies. (Merryman-East Central)

## 3046 - B1, D1, D2, D3, E2, E3, F1
## MANURE POWER,

Calf News, Vol. 14, No. 6, p. 14, 46, June, 1976.

Descriptors: Energy, Recycling, Feeds, Methane, Economics.
Identifiers: Cattle manure, Land spreading.

Developing new energy sources is a top priority for most of the world, and a number of scientists are eyeing feedlot manure as one potential. However, Dr. Judson M. Harper, head of the Agricultural Engineering Department at Colorado State University, Fort Collins, reported to CALF that producing methane gas from manure is not economically feasible. Methane fermentation is time consuming, requires large quantities of water, and solids remaining after fermentation still have to be disposed of. He suggested a better approach to be drying it to some extent and then burning it as a fuel in a trash-type broiler. The heating value of dry manure is essentially the same as the heating value of low-grade coal. By using the recycling system developed by Ceres Ecology, Inc., of Sterling, Colorado, a plant would obtain from feedlot manure a 45 percent non-protein-nitrogen product equal in value to soybeans and a fuel to operate the feed mill and other such community plants. The cost of a complete recycling unit including all the environmental protection requirements capable of handling the manure from 100,000 cattle would fall between one and two million dollars, according to Dr. Harper; whereas, a methane plant to handle 100,000 head, at one time considered for Monfort of Colorado, was pegged at ten million dollars. (Ott-East Central)

## 3047 - A8, B1, E2
## THE FATE OF FERTILIZER NUTRIENTS AS RELATED TO WATER QUALITY IN THE NORTH CAROLINA COASTAL PLAIN,

Department of Soil Science, North Carolina State University, Raleigh
R. P. Gambrell, J. W. Gilliam, and S. B. Weed
North Carolina Water Resources Research Institute Report No. 93, August, 1974, 151 p. 24 fig, 5 tab, 79 ref.

Descriptors: Fertilizers, Nutrients, Water quality, North Carolina, Nitrogen, Nitrates, Phosphorus, Agricultural runoff.

Quantities of nitrogen and phosphorus moving into surface and subsurface waters from cultivated soils of the North Carolina Coastal Plain, as affected by internal drainage, were determined. In a moderately well-drained soil, little denitrification was found; in a poorly drained soil with a high water table, much of the unutilized fertilizer nitrogen was lost from the field through denitrification. Little phosphorus was lost from either location studied except by surface movement with eroded sediments. Application of fertilizer nitrogen (224 kg/ha) resulted in an increase in loss of total nitrogen by surface runoff from both soils. Values were 29 percent for the moderately well-drained soil and 10 percent for the poorly drained soil. Nitrogen lost in surface runoff was almost exclusively organically bound, indicating that fertilizer applications serve to maintain the level of soil organic nitrogen. A 2-year nitrogen budget indicated that about 46 kg of residual nitrate-nitrogen/ha moved annually from moderately well-drained soil by subsurface drainage into nearby surface waters. Tile drainage accounted for about half of this nitrogen movement. Denitrification did not remove significant amounts of residual nitrate from the moderately well-drained soil. About 15 kg of nitrate-nitrogen/ha annually moved from poorly drained soil by subsurface drainage during the two winters. The smaller loss from poorly drained soil resulted from denitrification of residual nitrate in the shallow groundwater. Water management may increase the denitrification of unused soil nitrate and thus reduce the pollution potential. (Gambrell-North Carolina State Univ.)

## 3048 - A11, B1, C2

### THE DIETARY-FECAL RELATIONSHIP OF CALCIUM AND PHOSPHORUS LEVELS IN WHITE LEGHORN HENS,

Department of Poultry Science, Florida Agricultural Experiment Station, Gainesville
B. L. Damron, A. R. Eldred, D. A. Roland, Sr., D. B. Underhill and R. H. Harms
Poultry Science, Vol. 54, No. 5, p. 1716-1718, 1975. 2 tab, 2 ref.

Descriptors: Diets, Calcium, Phosphorus, Poultry.
Identifiers: Physiological requirements.

Chemical determinations indicate that hen feces contain appreciable quantities of several nutrients such as protein, calcium and phosphorus. This indicates the possible use of hen feces as an ingredient in poultry feeds. The authors collected manure from caged White Leghorn hens in an attempt to study the dietary and fecal interrelationships of calcium and phosphorus. When fecal calcium was increased by increasing dietary calcium, phosphorus levels in the feces decreased in an inverse relationship to calcium levels. When calcium levels were held constant, fecal calcium levels remained fairly constant as the phosphorus level increased. Each increment of supplemental phosphorus resulted in a concomitant increase of fecal phosphorus. The ratio of dietary to fecal phosphorus tended to stabilize at dietary levels above 0.43 percent, possibly indicating a "pass-through" situation after physiological requirements were met. (Penrod-East Central)

## 3049 - A3, A4, A5, A6, A8, B3, C2, E2

### DISPOSAL OF BEEF FEEDLOT MANURE,

Texas Agricultural Experiment Station, El Paso
D. L. Reddell and P. Lyerly
Progress Report PR-3279C, Texas Agricultural Experiment Station, Texas A & M University, September, 1975. 5 fig, 19 tab, 21 ref.

Descriptors: Waste disposal, Crop response, Water pollution, Groundwater pollution, Agricultural runoff, Nutrients, Soil profile, Odor, Nitrates.
Identifiers: Land disposal, Plowing.

Research was conducted at the Texas Agricultural Experiment Station in El Paso to study the following: (a) the ability of various tillage equipment to plow under up to 900 tons per acre of manure and cover with sufficient soil to eliminate odors, (b) deep plowing disposal techniques for possible pollution of surface water and (c) crop quality and yields from deep plowed field plots receiving large manure application rates. In May, 1970, beef manure was deep plowed into Vinton fine sandy loam at rates of 0, 300, and 900 tons per acre wet basis. Pollution level of irrigation runoff increased with manure application rate immediately following application, but rapidly decreased to background levels within a couple of months. Soil solution extracts taken from the unsaturated manure disposal plots indicated an increase in ammonium, organic-nitrogen, COD, sodium and chloride with manure application rate. These chemical constituents peaked and in most cases were decreasing by August, 1972. Ground water samples revealed an increase in chemical constituents with manure application rate. Concentrations peaked during 1971 and reduced to background levels by August, 1972. Although significant levels of nitrate accumulate in the soils receiving large manure applications, no detrimental nitrate level occurred in groundwater samples. Denitrification must have prevented this. Yields of corn silage and forage sorghum that were grown on plots receiving up to 900 tons per acre of manure were diminished the first year. However, yields increased during the second and third years. Nitrate levels in these crops were below the nitrate toxicity levels for feeding livestock. Nitrate levels of forage grown on the 300-ton per acre plots and the 900-ton per acre plots were comparable. (Penrod-East Central)

## 3050 - A8, A11, B1, C1, C2, C3, D1, D2, E3

### POULTRY POLLUTION: RESEARCH RESULTS,

Poultry Science Department, Michigan State University, East Lansing
C. C. Sheppard and C. J. Flegal, editors
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, 107 p.

Descriptors: Poultry, Pollution, Dehydration, Fertilizers, Soil profile, Performance. Identifiers: Refeeding, Anaphage.

This collection of papers deals with experiments concerning poultry manure analysis, poultry manure dehydration, poultry manure refeeding, and poultry manure used as a fertilizer. poultry health and performance, as a result of refeeding experiments, receives particular attention. (Merryman-East Central)

## 3051 - B3, C1, D1, E3, F1

### POULTRY MANURE DEHYDRATION BY AIR-DRYING AND MACHINE IN A CAGED LAYER-HOUSE HANDLING SYSTEM,

Agricultural Engineering Department, Michigan State University, East Lansing
M. L. Esmay, C. J. Flegal, C. C. Sheppard, J. B. Gerrish, J. E. Dixon, et. al.
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 2-13. 6 fig, 3 tab, 5 ref.

Descriptors: Dehydration, Energy, Costs.
Identifiers: Poultry manure, Air drying, Mechanical drying, Refeeding.

A demonstration project was conducted to design, construct and test a poultry laying house that would incorporate a complete system for waste removal and dehydration of the excreta for refeeding to poultry or other livestock. Excreta from caged poultry was allowed to accumulate on dropping boards in a poultry house throughout a 24 hour period. The droppings were hand scraped daily from the dropping boards into manure pits. They were scraped from the pits daily by a cable-blade scraper into a cross-conveyer and immediately onto a drying belt where they stayed for another 24 hours. On the second day, the excreta on the belt was conveyed into the dryer. A drying period of 2 or 3 hours of machine time was required during which waste heat from the dryer and afterburner was directed through the dryer and out of the house. Thus it is seen that water was removed from the poultry excreta in four stages: (1) on the dropping boards by ventilation air, (2) on the belt by ventilation air, (3) on the belt by waste heat from the dryer, and (4) as it was being run through the dryer. The dry matter output and moisture removal capability of the machine dryer appeared to decrease when lower moisture excreta was fed into it (as in June, July, and August) during which the excreta going into the dryer varied from 48-59 percent as compared to the colder months when it varied at a higher level from 58-68 percent. Fuel cost for the heated air machine drying was about one cent for each pound of water removed with an assumed fuel cost of 34 cents a gallon. This research was still in process at the time this paper was written. (Merryman-East Central)

## 3052 - A8, E2

### CORN GRAIN YIELDS AND CHANGES IN SOIL FERTILITY LEVELS AS AFFECTED BY FIVE RATES OF POULTRY MANURE,

Department of Crops and Soil Sciences, Michigan State University, East Lansing
L. S. Robertson and J. H. Wolford
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 14-20. 1 fig, 4 tab, 3 ref.

Descriptors: Soil profile, Crop response, Nutrients, Water pollution.
Identifiers: Corn, Disposal rates, Poultry manure, Soil pollution.

Field experimental plots were established in Huron County, Michigan, in 1967 to determine how much manure could be used before problems would be caused in relation to the corn production or to the soil. Five treatments were originally made with a sixth added after the first year. The soil treated was of the Sims and Breckenridge series, and for years had annually received varying rates of poultry manure. Thus, it was a fairly fertile soil even before these experiments began. The treatments, which were replicated four times, included: (a) no manure and no fertilizer (check), (b) commercial fertilizer only, 150 + 150 + 150 (N + $P_2O_5$ + $K_20$), (c) 5.8 tons/acre/year (moist weight) of chicken manure, (d) 11.6 tons/acre/year of chicken manure, (e) 23.2 tons/acre/year of chicken manure, (f) 46.4 tons/acre/year of chicken manure. Both the fertilizer and the manure were broadcast and plowed under in the fall. After 5 years, composite soil samples of the surface soil were collected from each plot and analyzed. Corn grain yields were determined each year. The average corn grain yields were exceptionally high, ranging between 139 and 151 bushels per acre for the 5-year period. The manure increased the carbon, nitrate nitrogen, phosphorus, potassium, calcium, magnesium, zinc, and sodium levels in the soil in varying degrees. With rates of chicken manure in excess of 20 tons/acre, the possibility of soil and water pollution increased rapidly. (Merryman-East Central)

## 3053 - A8, C2, E2

### NUTRIENT DISTRIBUTION IN PROFILE OF SOIL TREATED WITH A HIGH RATE OF CHICKEN MANURE,

Department of Crops and Soil Sciences, Michigan State University, East Lansing
L. S. Robertson, J. H. Wolford, and P. Godz
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 21-28. 5 tab.

Descriptors: Nutrients, Soil profile, Poultry, Crop response, Fertilizers.
Identifiers: Corn.

Research was done to evaluate the accumulation of plant nutrients from chicken manure in surface soil and to determine the extent of nutrient movement into subsurface zones when chicken manure was used at high rates in a corn monoculture system. Check plots ("no manure" and "no fertilizer") and manure treated plots were established on a Sims-Breckenridge soil in Huron County, Michigan. Only the plots receiving 46.4 tons/acre/year were compared in this report to the check plots. Statistically, the manure did not increase the corn yield to a higher level than was produced on the check plots. Two factors may account for this. High rates of manure had been used in the plot area for some time before the experiment was initiated. Also, the Breckenridge soil is a two-storied soil, where there are opportunities for lateral movement of certain nutrients, especially nitrate nitrogen, from the treated plots into the check plot areas. However, poultry manure was found to be a good source of plant nutrients for corn. It was estimated from the average composition of chicken manure that 20 tons per acre used on an annual basis would more than satisfy the nutrient requirements for a 150-bushel corn crop. It was found that poultry manure used at the rate of 46.4 tons /acre decreased the pH of the soil and increased the levels of available phosphorus within the soil profile to a depth of 42 inches by 140 percent; potassium, 172 percent; nitrate-nitrogen, 954 percent; ammonium-nitrogen, 126 percent; and total nitrogen, 53 percent. Sodium levels were increased slightly. Zinc collected in the surface soil, as did copper. The manure did not greatly change the levels of available calcium, magnesium, iron, manganese, or chloride. The nitrogen in the manure was retained within the soil profile. (Merryman-East Central)

### 3054 - A11, B3, E3 300

### FERTILITY AND HATCHABILITY IN SINGLE COMB WHITE LEGHORNS FED VARYING LEVELS OF POULTRY ANAPHAGE,

Poultry Science Department, Michigan State University, East Lansing
C. J. Flegal, D. Dorn, M. X. Gomez and H. C. Zindel
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 29-38. 6 tab. 1 ref.

Descriptors: Poultry, Performance, Diets.
Identifiers: Fertility, Hatchability, Refeeding, Poultry anaphage.

Twenty-four troups of 5 ready-to-lay S.C.W.L. females plus one S.C.W.L. male were randomly assigned 4 experimental diets, with 6 replicate groups being fed each diet. Diet 1, a basal diet, was a typical corn /soya layer ration. The other 3 diets contained 3 levels of poultry anaphage (6.25, 12.5, and 25 percent) which replaced an equivalent percentage of corn in the basal diet. In the first 3 weeks of the experiment, only egg production data were recorded. During Phase I (week 4 to week 11) of the experiment, all females were inseminated once each week. During Phase II (week 12 to week 15), the inseminations were increased to twice per week. There was statistically no significant difference in the percent egg production from the birds fed any of the poultry anaphage supplemented diets and the egg production of the birds fed the control diets. Percent fertility of eggs produced during Phase I by the birds fed the poultry anaphage diets showed no statistical difference from those fed the corn /soya diet. The poultry anaphage diets had no significant effect on the percent hatchability of fertile eggs produced during Phase I. With continued feeding of the diets that contained poultry anaphage during Phase II, the mean percent fertility declined 1.7 percent, when compared to the fertility data from the corresponding earlier period. The poultry anaphage diets continued to show no effect on percent hatchability of fertile eggs when the diets were fed for the continued period of week 11 to week 15. The inconsistent trends in fertility among the birds fed increasing levels of supplemental poultry anaphage need to be further investigated. More valid data on fertility could be obtained during a combined system of natural mating and artificial insemination. (Merryman-East Central)

### 3055 - A11, B3, C2, E3 300

### BIOLOGICAL AVAILABILITY OF PROTEIN FROM POULTRY ANAPHAGE,

Poultry Science Department, Michigan State University, East Lansing
D. Polin and K. M. Chee
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 39-51. 2 fig. 7 tab. 9 ref.

Descriptors: Poultry, Diets, Proteins, Performance.
Identifiers: Refeeding, Poultry anaphage, Quail.

Day-old Japanese quail were reared in a battery-brooder for 7 days and fed a diet that contained 15 percent protein, with the idea that protein from growth would be marginal. On day 7, the quail were weighed, then sorted by weight and transferred as groups of 15 of nearly equal body weight to a battery-brooder with 24 pens. Twelve dietary treatments, with 2 replications per treatment, were assigned at random. The test diets and a practical diet were then fed for 7 days. One set of diets was formulated to provide protein only from isolated soy protein (I.S.P.), supplemented with methionine. The other set of diets contained the same gradient amounts of isolated soy protein, plus poultry anaphage as the other source of protein. All diets were isocaloric. Quail receiving anaphage ate consistently more feed than the check group. However, when the total feed consumed was corrected for the anaphage as 30 percent of the dietary weight, the actual amounts of the basal mix and thus I.S.P. consumed by the quail receiving anaphage were less than those fed the diets without anaphage. Despite this, the final body weights and body weight gains were consistently greater than their counterparts receiving the comparable feed level of I.S.P. Nitrogen intake per bird was much higher in quail fed anaphage. Carcass N was generally higher for this group. It was determined that between 12.3 to 13.7 percent of crude protein was available from anaphage. Based on the "true protein" value determined by precipitation with trichloroacetic acid or amino acid analysis, essentially all of this protein would appear to be available to the bird. The "true protein" value obtained by chemical methods would appear to be a good assessment of the true protein in anaphage. ((Merryman-East Central)

### 3056 - A11, B3, D1, E3 300

### EFFECT OF DEHYDRATED POULTRY ANAPHAGE ON TURKEY BREEDER HEN EGG PRODUCTION,

Poultry Science Department, Michigan State University, East Lansing
J. H. Wolford, G. O. Fadika, J. R. Beck, and C. J. Flegal
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 52-57. 2 fig, 2 tab, 9 ref.

Descriptors: Poultry, Feeds, Performance, Design, Mortality.
Identifiers: Dehydrated poultry anaphage, Refeeding, Cracked eggs.

A project was designed to evaluate the performance of caged turkey breeder hens fed dehydrated poultry anaphage. In addition, different types of cage floor bottoms were evaluated. Large white turkey hens were housed two per cage in a light-controlled building. The cages were 18 inches deep by 28 inches wide, with a 2-inch back-to-front slope. The dehydrated poultry anaphage was obtained by collecting the feces of these caged turkeys from 20 to 24 weeks of age and dehydrating them in a machanical heat dehydrator. The anaphage was fed from 31 weeks of age to the end of the experimental period at the dietary rate of 12.5 percent. Mortality was not appreciably influenced by feeding dehydrated poultry anaphage nor by the type of cage in which the birds were housed. The number of eggs produced was not significantly influenced by cage design; however, egg production was significantly improved by feeding a diet containing 12.5 percent dehydrated poultry anaphage. The number of cracked and broken eggs was significantly decreased in the cages having rubber-coated wire floors. The welded wire floor resulted in a 15.8 percent incidence of cracked and loss eggs, whereas the incidence was 8.3 and 4.9 percent for the floors having a thin or thick rubber coat, respectively. Neither feeding dehydrated poultry anaphage nor cage height had a significant influence on cracked and loss egg incidence. (Ott-East Central)

### 3057 - A11, B3, D1, E3, F3 300

### EGG PRODUCTION AND FERTILITY OF CAGED TURKEY BREEDER HENS FED DEHYDRATED POULTRY ANAPHAGE,

Poultry Science Department, Michigan State University, East Lansing
J. H. Wolford
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 58-62. 2 tab, 2 ref.

Descriptors: Poultry, Feeds, Performance.
Identifiers: Dehydrated poultry anaphage, Refeeding, Egg production, Fertility, Hatchability.

In a preliminary experiment, Wolford showed that dehydrated poultry anaphage could be fed to caged turkey breeder hens without any detrimental effect on egg production. This experiment was conducted to further evaluate dehydrated poultry anaphage as a feed ingredient for caged turkey breeder hens. In addition to egg production data, fertility and hatchability records were kept. Forty-eight Nicholas large white turkey hens were obtained from a commerical grower when the birds were 30 weeks of age. The birds were placed in cages (2 birds per cage) and provided a 14 hour artificial light day. The experiment was conducted for 84 days. Dehydrated poultry anaphage was incorporated into the diet at the 10 percent level and fed to the hens throughout their entire reproductive period. During the last 23 days of the experiment, fertility and hatchability data were collected. Each hen was imseminated weekly with 0.05 ml of pooled semen collected from males that received the control diet. The egg production was not significantly altered by feeding a diet containing 10 percent dehydrated poultry anaphage; however, there was a four egg per bird advantage for the birds fed dehydrated poultry anaphage. The percentage of shell-less, cracked, and broken eggs was not appreciably affected by the dietary alteration. Fertility and hatchability were not detrimentally influenced by feeding dehydrated poultry anaphage to turkey breeder hens during the reproductive period. Livability, ending body weight, and foot swelling score were not affected by feeding dehydrated poultry anaphage. (Ott-East Central)

### 3058 - A11, B1, C2, D1, E3 300

### CAGE FLOOR TYPE AND DEHYDRATED POULTRY ANAPHAGE: EFFECT ON REPRODUCTIVE PERFORMANCE OF TURKEY BREEDER HENS AND THEIR PROGENY,

Department of Animal and Veterinary Sciences, University of Maine, Orono
J. H. Wolford, G. O. Fadika, S. Iturri, and R. K. Ringer
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 63-73. 5 tab. 5 ref.

Descriptors: Poultry, Performance, Reproduction, Fertility, Hatchability.
Identifiers: Anaphage, Refeeding, Floors, Cracked eggs.

Four experiments, 2 with adult and 2 with poults (both sexes), were performed. In experiment 1, fifty-six 28-week old Nicholas large white hens (female-line) were placed in cages. Cage floors were 2" x 4" welded wire covered by either a soft plastic insert mat, hard plastic, or Bressler plastic. A 10 percent dehydrated poultry anaphage diet was fed to the appropriate birds. From December 10, 1973-February 11, 1974, each hen was inseminated weekly with pooled semen collected from males not fed anaphage. Fertility and hatchability data were collected. Experiment 2 was like experiment 1 except: (1) 88 day-old Nicholas large white turkey poults were grown to 17 weeks of age on litter or in cages, then transferred to cages like those in experiment 1 or placed in a litter floor pen at 8.25 sq. ft /bird density and fed a standard growing ration until 28 weeks old. (2) Then, all birds received a breeder "control" diet. (3) The cage floors were covered with either a soft plastic mat or hard plastic slats. The litter floor was covered with wood shavings. In experiment 3, 60 poults were randomly selected from a scheduled hatch of eggs produced by experiment 1 birds—30 from eggs produced by hens on the anaphage diet; 30 from eggs produced by hens not fed anaphage. The poults were grown to 4 weeks of age in wire floor batteries and received a starter diet. They were then weighed and serum samples were collected at the time of sacrifice from the first 10 males and 10 females handled. Samples were analyzed for creatinine, calcium, phosphorus, alkaline phosphatase, glutamic pyruvic transaminase, cholesterol, total phosphokinase, phosphokinase enzyme, glucose, and total protein. Experiment 4 was like experiment 3, except that it was conducted 16 days later with poults hatched on January 31, 1974. Floor type significantly influenced the number of intact eggs produced. In experiment 1, birds housed on soft plastic insert mats averaged 8 percent cracked eggs whereas, birds housed on hard plastic slats and Bresler plastic averaged 26.8 and 10.4 percent cracked eggs, respectively. Feeding dehydrated anaphage to caged turkey breeder hens did not significantly alter egg production, fertility, or hatchability of fertile eggs. The percentage of cracked eggs in experiment 2 was greater in the floor-housed turkey breeder hens than in the breeder hens housed in cages with soft plastic insert mats. Fertility and hatchability were lower for floor-housed birds. (Merryman-East Central)

## 3059 - A11, B3, C2, E3 300

## PERFORMANCE AND BLOOD ANALYSES OF GROWING TURKEYS FED DEHYDRATED POULTRY ANAPHAGE,

Poultry Science Department, Michigan State University, East Lansing
G. O. Fadika, J. H. Wolford, and C. J. Flegal
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 74-87. 1 fig. 8 tab. 26 ref.

Descriptors: Performance, Poultry, Phosphorus.
Identifiers: Turkeys, Blood analysis, Dehydrated poultry anaphage, Refeeding, Uric acid.

An experiment was conducted to study the effect of feeding dehydrated poultry anaphage on the performance and blood constituents of growing turkeys from 9-17 weeks of age. Commercial 9-week-old straight run Broad Breasted White turkeys were weighed and randomly assigned to 4 diets which contained 0, 5, 10 and 30 percent dehydrated poultry anaphage. Mortality was not affected by feeding poultry anaphage. The overall body weight gain during the study was not significantly altered by the poultry anaphage. However, a numerical decrease of 0.33 kg per bird, in comparison to the control group, was observed in the birds that received 30 percent dehydrated poultry anaphage in their diet. Feed efficiency was inversely related to the level of anaphage in the diet, with conversion figures being 3.35, 3.40, 3.48, and 3.63 kg feed per kg body weight gain for the 0, 5, 10, and 30 percent anaphage diets, respectively. Feeding of poultry anaphage appeared to have no significant effect on plasma uric acid levels. Plasma phosphorus level was significantly increased by feeding 30 percent poultry anaphage. (Merryman - East Central)

## 3060 - B3, C1, C2, D1, D2 300

## THE EFFECT OF DEHYDRATORS ON THE NUTRIENTS OF POULTRY ANAPHAGE,

Department of Poultry Science, Michigan State University, East Lansing
T. S. Chang, D. Dorn, and E. Linden
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 88-92. 3 tab, 8 ref.

Descriptors: Dehydration, Equipment, Chemical properties, Physical properties, Nutrients.
Identifiers: Anaphage, Poultry excreta.

Five experiments were conducted to compare the nutrient value of anaphage dried in 2 different dehydrators. The anaphage was analyzed for calcium, phosphorus, ash, crude fiber, moisture, crude protein and protein nitrogen. Dryers were operated according to the manufacturers' instructions. Two thousand pounds of fresh poultry excreta were collected and divided into 2 portions, each of which was immediately dried by a designated dehydrator (Dryer I or II). The results showed that the calcium, ash and protein values of the anaphage from Dryer I were consistently higher than those of the anaphage from Dryer II. The pattern of certain nutrient ingredients changed when values were converted to dried weight basis. However, the overall comparison of nutrient values between the 2 dryers remained the same. Average nutrient values for the 5 experiments were calculated. According to Lohrding's test of 2 means, the results showed that the values of calcium, ash, moisture, crude protein, and corrected protein were significantly different. (Ott-East Central)

## 3061 - A11, B3, C1, C2, C3, D1, D2, F1 300

## PRELIMINARY REPORT ON THE MICROBIOLOGICAL AND CHEMICAL ANALYSES OF ANAPHAGE FROM A COMPLETE IN-HOUSE DRYING SYSTEM,

Department of Poultry Science, Michigan State University, East Lansing
T S. Chang, D. J. Currigan, J. E. Dixon, M. L. Esmay, C. J. Flegal, et. al.
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 93-97. 1 fig, 1 tab, 8 ref.

Descriptors: Microorganisms, Chemical properties, Bacteria, Physical properties, Moisture content, Nutrients, Costs.
Identifiers: Anaphage, Dehydration.

Microbiological and chemical analyses were performed on anaphage produced by drying fresh excreta in an in-house drying system at Michigan State University. The purpose of the microbiological analyses was to comply with FDA recommendations to safeguard animal health. Anaphage samples were collected directly from the dehydrator to lessen the possibility of contamination. Moisture content was immediately determined and microbiological analyses were performed. Average aerobic microbial count was 1,407 bacteria per gram of anaphage. Anaerobic count was 1,102 bacteria per gram of anaphage. Most of the organisms were Bacillus sp. and Streptococcus sp. No Salmonella sp. or mold was isolated. It was evident that moisture content of the sample affected the microbial count. Low moisture content seemed to coincide with the low aerobic bacterial count. Average crude protein and corrected protein were found to be 39.37 percent and 18.65 percent, respectively. Calcium and phosphorus values were 9.11 percent and 1.74 percent, respectively. Moisture content of the anaphage was extremely low. The cost of dehydration would be lower if the moisture content was increased to about 10 percent, since most feed ingredients have approximately 10-15 percent moisture content. (Merryman-East Central)

## 3062 - A6, B4, C2, D1 300

## AMMONIA CONTENT OF CAGED LAYER EXCRETA,

Department of Poultry Science, Michigan State University, East Lansing
T. S. Chang, D. J. Currigan, and E. Linden
Research Report 269, "Poultry Pollution: Research Results", Agricultural Experiment Station, Michigan State University, February, 1975, p. 98-107. 3 fig. 5 tab. 12 ref.

Descriptors: Ammonia, Waste storage, Temperature, Humidity.
Identifiers: Excreta, Magnesium oxide.

Results are reported for 8 experiments which determined the ammonia content of cage layer excreta at various storage periods after excretion. Experiments were set up as follows: Trial one — Excreta samples were collected from 3 hens. Samples were placed on non-absorbent paper and left on a laboratory bench. Ammonia content was determined at 10-, 20-, 30-, and 120-minute intervals; Trial Two — A composite excreta sample from 4 hens was collected and placed on a laboratory bench. Ammonia content was determined each half hour from 1½ to 5 hours at 24 degrees C with a relative humidity of 25 percent; Trial Three — A composite excreta sample from 5 hens was collected at half-hour intervals. Samples were kept at 34 degrees C and a relative humidity of 30 percent with a fan running continuously; Trials Four through Seven — A composite excreta sample of 8 hens was collected at half-hour intervals. Samples were stored immediately in an oven at 34 degrees C with a relative humidity of 60 percent. A total of 4 samples was collected. Three replicates of each sample were tested for ammonia content. Gas chromatographic and organoleptic techniques were used by other investigators to determine the odor-producing materials. The magnesium oxide method for ammoniacal nitrogen can be adopted for determining the ammonia content of the excreta after conversion from the ammoniacal nitrogen value. The moisture content in the oven can offset the rate of ammoniacal release from excreta. The amount of ammonia content in the excreta increases with length of storage time. (Merryman-East Central)

## 3063 - A11, B1, E2 400

## DAIRY COWS GO IN CIRCLES,

T. Curl
Progressive Farmer, Vol. 91, No. 5, p. 30, May, 1976. 1 fig.

Descriptors: Dairy industry, Design.
Identifiers: Waste management, Waste disposal.

Mud problems and increasing automation costs have prompted the Millers to adopt a new milking system — a double rotary parlor arrangement. The milking time has been cut from 18 hours per day to 8 hours and several people who were previously tied up with milking have been moved to the farming operation that grows forage for the cows. In the new system, the milking crew consists of one milker in each rotary parlor and one man who brings cows to the concrete crowding pen, washes them, and inspects them for sickness and heat periods. Each unit handles 8 cows at a time as they travel a circle before leaving the parlor. A free-stall loafing area, a minimountain that is 12 feet high on top and slopes at a 3 percent grade to 12 inches above grade at the lower end, has been provided for the cattle. Alleys are concrete and the stalls are dirt. Animal waste in the loafing area is moved by use of 3,000 gallons of water impounded in holding tanks at the top of the slope at each alley or pen. This cleaning takes place twice daily. The waste and water are gathered at the bottom of the slope where a separator takes out most of the solids. The liquid portion is returned to the holding tanks at the top of the slope for reuse. The solids are used as farm fertilizer. While the radical shift in housing and milking facilities hasn't had any dramatic effect on milk production yet, the Millers now feel that they have the equipment and potential to expand the herd while keeping a tight rein on labor expenses. (Merryman-East Central)

## 3064 - A11, B1

## AEROBIC DIGESTED MUNICIPAL GARBAGE AS A FEEDSTUFF FOR CATTLE,

Georgia Coastal Plain Experiment Station, Tifton 31794
J. C. Johnson, Jr., P. R. Utley, R. L. Jones, and W. C. McCormick
Journal of Animal Science, Vol. 41, No. 5, p. 1487-1496, November, 1975. 2 fig, 6 tab, 16 ref.

Descriptors: Feeds, Cattle, Performance, Polychlorinated biphenyls, Heavy metals.
Identifiers: Garbage, Intake.

The potential of Fairfield process garbage as a feedstuff in cattle diets for support of lactation and growth was assessed at the Georgia Coastal Plain Experiment Station. Diets of similar composition formulated with 17.5 percent digested garbage product (garbage diet) or 17.5 percent cottonseed hulls (control diet) were fed to lactating Jersey cows, growing Jersey bull calves, and Charolais cross bred and Hereford steers. Measurements were taken of voluntary intake, digestibility, animal performance, and heavy metal, pesticide and polychlorinated biphenyls (PCB's) content of dietary materials and animal tissues. The study data showed dry matter, crude fiber and nitrogen-free extract in the garbage diet to average 12, 29, and 16.8 kg of daily intake and milk production per cow for the control diet. Intake and weight gains by calves during 91 days of comparison averaged 34 and 61 percent higher for the control diet and 6.12 or 6.86 kg of control or garbage diet was required per kg of gain. Beef steer intake of the control diet in a two-period, 14 days per period, reversal experiment exceeded that of the garbage diet by 29 percent. While the study showed that Fairfield process garbage has nutritional value as a feedstuff, depressed intake and relatively high levels of lead and PCB's were identified as potential dangers associated with utilizing digested garbage in high fiber diets for cattle. (Penrod-East Central)

## 3065 - A6, B1, F2
### GUIDELINES FOR ODOR CONTROL.
Anonymous
Wallaces Farmer, Vol. 101, No. 6, p. 55, March 27, 1976.

Descriptors: Legal aspects, Iowa, Regulation.
Identifiers: Odor control, Guidelines, Permits.

By law, the Department of Environmental Quality (DEQ) has the authority to control odors, but it can't take any action until it has departmental rules. An odor advisory control panel is trying to set up recommendations. Three basic assumptions made in setting the regulations are: (1) An Iowa law can't be passed which violates federal law; (2) It is assumed that nonhog raisers don't like the smell of hogs, and (3) It must be noted that if someone detects a hog smell, it doesn't necessarily mean that he is badly offended. Presently, file 367, which has passed the senate and is in the house, would allow a 10-year exemption from future regulations for facilities issued a permit under the Iowa code. It also says that a facility owner is no longer liable for a nuisance suit if he has a permit. The former rule could be negated if the Iowa code did not meet new federal regulations. The second rule has been ruled by the attorney general to be unconstitutional. Another bill currently in committee deals with construction compliance permits. According to this bill, if a facility is built to DEQ standards and is issued a construction compliance permit, it is exempt from further odor regulations for 10 years. A big problem is measuring odors. Methods tried include the threshold approach and odor panels. The advisory committee for Iowa's Department of Environmental Quality is considering the use of a butyl alcohol for measuring odor intensity. The advisory committee also plans to suggest that odor complaints first be filed with the county board of health. If the person making the complaint isn't satisfied, he can then appeal to the Air Quality Commission of the Department of Environmental Quality. Odor intensity and frequency would then be measured. There could then be a formal request for compliance if odor was found to be a problem. Court action would be a final step if the problem isn't resolved. (Merryman-East Central)

## 3066 - A11, B1, C2, D1, E3
### CHICKENS PROVIDE NEW PROTEIN FEED,
Anonymous
Calf News, Vol. 14, No. 6, p. 29, June, 1976.

Descriptors: Feeds, Cattle
Identifiers: Refeeding, Poultry manure, Ceres Ecology, Inc., Non-protein-nitrogen, Drying.

Ceres Ecology, Inc. of Sterling, Colorado, which has finished its laboratory and pilot plant work on converting poultry manure into 40-45 percent non-protein-nitrogen feed value at $70 per ton, is constructing a demonstration poultry manure processing plant at their feedlot location in Sterling. Three ingredients similar to their cattle manure processing products will be produced: (1) C-1 silage, (2) C-2 protein, and (3) C-3 residue material. C-2 is the best form of non-protein-nitrogen. It has been tested by the USDA and was found to be a much better form of non-protein-nitrogen than urea or biuret. It is slow releasing. David Seckler, head of Ceres Ecology, feels that the system may offer a good supply of non-protein-nitrogen for the cattle feeding industry. (Merryman-East Central)

## 3067 - A11, E3
### THE EFFECTS ON EGG PRODUCTION AND EGG COMPOSITION OF ADDING SUPPLEMENTS OF AMINO ACIDS AND /OR UREA OR DRIED AUTOCLAVED POULTRY MANURE TO A LOW-PROTEIN LAYER DIET,
Agricultural Research Council's Poultry Research Center, King's Buildings, West Mains Road, Edinburgh, Scotland
R. Blair and D. J. W. Lee
British Poultry Science, Vol. 14, No. 1, p. 9-16, 1973. 4 tab, 21 ref.

Descriptors: Poultry, Diets, Performance, Amino acids, Urea, Nitrogen, Proteins.
Identifiers: Egg production, Egg composition, Dried autoclaved poultry manure.

Thirty-five medium weight hens, aged 10 months, were used in an eight week experiment. They were fed a basal diet containing 11.5 percent protein or the same diet supplemented with 1.54 percent essential amino acids and /or with 2 sources of nitrogen for the synthesis of non-essential amino acids (1.15 percent urea or 9.7 percent dried autoclaved poultry manure.) Supplementation with essential amino acids resulted in improved egg production, food intake, food conversion efficiency, gross efficiency of nitrogen conversion, and the ability of hens to maintain body weight. Supplementation with dried autoclaved poultry manure improved food intake, total egg mass, and mean egg weight. Supplementation with urea alone did not significantly increase food intake or improve egg production. It was also found that supplementation with essential amino acids and urea to give the equivalent of 16 percent protein did not result in significantly higher egg production than that obtained with urea alone. While gross composition of eggs was not influenced significantly by dietary treatment, albumen quality was found to be significantly lower on the basal diet and significantly higher on the supplemented diets. (Penrod-East Central)

## 3068 - A6, B1
### CONSIDER PREVAILING WINDS IN FEEDLOT SITE SELECTION,
Texas Agricultural Extension Service, Texas A&M University, College Station
J. M. Sweeten
Publication G 73-53, University of Nebraska, Cooperative Extension Service, November, 1973, 4 p. 3 fig, 7 ref.

Descriptors: Odor, Feedlots, Winds, Temperature, Rainfall, Climates.
Identifiers: Site selection.

The most important element of a feedlot odor abatement program consists of judicious site selection. This involves a study of local climatic factors to minimize the probability of odor drift into nearby population centers. Feedlots should be located as far as possible away from population centers or closest neighbors in the direction of least probability of wind occurrence. The optimum direction can be determined from published wind rose diagrams or from tabular wind direction data. Of particular importance is wind data from summer months when peak temperature and rainfall (and hence odors) occur. An ideal criterion for feedlot site selection would be to select a location that has the least chance of an adverse wind direction occurring in conjunction with or soon after a rainfall event. If feedlot odors are minimized during the most critical periods of adverse moisture and temperature, the wind speed factor is probably less important than wind direction consideration. (Merryman-East Central)

## 3069 - A5, A8, B1, E2
### FORMULAS FOR APPLYING ORGANIC WASTES TO LAND,
Kansas State University, Manhattan
W. L. Powers, G. W. Wallingford, and L. S. Murphy
Journal of Soil and Water Conservation, Vol. 30, No. 6, p. 286-289, November-December, 1975. 3 fig, 1 tab, 15 ref.

Descriptors: Organic wastes, Nutrients, Nitrogen, Salts, Toxicity.
Identifiers: Land application, Formulas, Soil-plant system, Application rates.

Organic wastes can supply needed plant nutrients. However, to insure the continued functioning of the soil-plant system, application rates should be determined. The ability of the soil-plant system to recycle nitrogen could be the best criteria for determining application rates, since nitrogen may limit plant growth and threaten groundwater quality. Some consideration should be given to other toxic substances that may build up in the soil-plant system. The authors have developed two formulas for application rates based upon the criteria mentioned above and other parameters. A sample demonstration of the formulas shows the potential salt build-up in the soil from inorganic salts in beef feedlot manure. Field data proves the validity of the calculations. The authors suggest that the formula can be used to plan research into values of unknown parameters. (Penrod-East Central)

## 3070 - A11, A12, B1, C2
### ADDITIVE CUTS CATTLE FEED NEEDS 10 PERCENT,
Anonymous
Chemical and Engineering News, Vol. 54, No. 1, January 5, 1976.

Descriptors: Additives, Performance, Digestion, Methane, Carbon dioxide.
Identifiers: Feed additives, Rumensin, Food and Drug Administration, Rumen.

To improve weight gain per pound of feed consumed in beef cattle, Eli Lilly Co. has introduced a chemical called Rumensin (monensin sodium). The use of Rumensin has been approved by FDA for use in feedlot cattle. Rumensin alters the digestive process in the beef animal's rumen where cellulose and starch are converted to sugars. Anaerobic bacteria convert the sugars to pyruvic acid and then to volatile fatty acids. These fatty acids are the rumen animal's source of energy. The Rumensin reduces the waste of energy by allowing less carbon dioxide and methane to be formed. In tests, cattle were fed Rumensin at a rate of 30 grams per ton of total ration. On the average, when Rumensin was added, 8.46 lbs of feed was required per pound of weight gain as compared to 9.46 lbs of feed per pound of weight gain without the additive. Thus, a 10 percent increase in efficiency was achieved. Rumensin left no detectable residue and had no effect on quality of meat composition. (Penrod-East Central)

## 3071 - A6, B1, F2
### NEAT LOT STOPS ODOR COMPLAINTS, EXPERT ADVISES,
Anonymous
Beef, Vol. 12, No. 7, p. 25, March, 1976.

Descriptors: Odor, Legal aspects, Management, Agricultural runoff, Water pollution.

Ron Miner, agricultural engineer at Oregon State, emphasized that "feedlot odors have never hurt anybody—and never made anybody sick!" But he went on to outline some steps feedlot operators could take to prevent being caught in an odor lawsuit. Miner noted that the feeder who insists on building upwind from a residential area is simply asking for trouble. He emphasized the importance of keeping feedlot waste as dry as possible. If an operation looks dirty—people will detect odors much faster than around a neat, clean operation. Feedlot waste in the river is sure to bring complaints about odors. Miner noted there are chemicals that offer some promise in controlling odors—but there still aren't any magic ingredients that will eliminate the problem. Finally, if a lawsuit comes, don't take it lying down. He advises calling in expert help—to get an accurate measure of intensity and duration of odor problems. Usually measurements will show it isn't as bad as the outsiders claim. (Ott-East Central)

### 3072 - A8, A11, B2, E2
### THE EFFECTS OF SLURRY ON THE ACCEPTABILITY OF SWARDS TO GRAZING CATTLE,

Department of Zoology, University of Reading
D. M. Broom, B. F. Pain, and J. D. Leaver
Journal of Agricultural Science, Vol. 85, Part 2, p. 331-336, October, 1975. 7 fig, 3 tab, 4 ref.

Descriptors: Slurries, Cattle, Crop response.
Identifiers: Swards, Grazing, Land disposal.

An experiment was designed to determine whether or not cattle would distinguish between, or prefer swards dressed with slurry at different rates and, if so, for how long. In this experiment 8 plots, each measuring 16m x 16m with 5-m-wide pathways, were set out on a meadow fescue, timothy, perennial ryegrass, white clover ley on a sandy soil. In each plot, 4 rates of application of cow slurry were allocated at random to four sub-lots. The slurry was applied at 0, 25, 40, and 100 t/ha to half of the plots on March 15, 1973, and to the rest of the plots on March 23, 1973. All plots received 100 kg/ha N as 'Nitro-Chalk' in early spring and again after they were grazed in May. Twelve Friesian heifers were used in the experiment. Their live weight at the beginning of the experiment averaged 303 kg and their age 13 months. The heifers were divided into three groups according to their live weight. The heifers were put into the plots 7 and 13 weeks after slurry application and were able to choose in which of the sub-plots they spent their time and grazed. The main effect of slurry on the pasture at 7 weeks was to increase the height of sward but to decrease herbage dry-matter production. Herbage dry-matter utilization over the 4 days ranged from 94 percent on the no-slurry sub-plot to only 41 percent when slurry had been applied at 100 t/ha. The heifers spent the most time in and grazed more often in sub-plots with little or no slurry for the first 2 days, but as the grass was eaten down the frequency of grazing on areas with more slurry increased. This was reflected in the amount of grass removed by the heifers from each treatment on each day. At the beginning of the second grazing, grass height and herbage dry-matter production were both directly related to level of slurry application. The heifers did not distinguish between treatments up to 50 t/ha, but herbage utilization on the 100 t/ha sub-plot was reduced. (Ott-East Central)

### 3073 - A2, A4, F2
### NBC REQUESTS EXEMPTION FROM RUNOFF RULES,

Anonymous
Feedstuffs, Vol. 48, No. 6, p. 22, February 9, 1976.

Descriptors: Poultry, Regulation, Water pollution.
Identifiers: Broilers, National Pollutant Discharge Elimination System.

The National Broiler Council (NBC) has filed a request with the Environmental Protection Agency asking an industry exemption from proposed regulations that would require National Pollutant Discharge Elimination System (NPDES) permits for large broiler operations. Broiler growout operations with more than 290,000 birds for a cumulative total of 45 days in any 12-month period would be considered a "concentrated animal feeding operation point source" in the eyes of the regulation. In the event EPA cannot grant an industry exemption, NBC said the criteria for determining whether a broiler operation has a measurable discharge of pollutants into navigable waters should be clarified. (Ott-East Central)

### 3074 - B1, D3, E3, F1
### ECONOMIC ANALYSIS OF DAIRY-MANURE BIO-GAS SYSTEMS,

Vermont University, Burlington
J. C. Oppenlander, E. A. Cassell, and R. N. Downer
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4545, 32 p. 1 fig, 15 tab, 4 ref.

Descriptors: Recycling, Economics, Dairy industry, Vermont, Gases, Fuels, Anaerobic digestion.
Identifiers: Bio-gas systems.

With the rapid upward trend in fertilizer and farm energy costs, considerable interest has been shown in the development of systems which can efficiently utilize the fertilizer and the energy potential of cow manure. Therefore, a research project was conducted at the University of Vermont to determine a technically feasible anaerobic digestion system which is compatible with dairy farm management practices in Vermont. This report summarizes the assessment of the economic feasibility of these anaerobic digestion systems as an energy source for tie-stall operations on Vermont dairy farms. Various design, energy, and economic recommendations were developed in this study. Minimum annual costs ranged from $8600 for 20 cows to $24,000 for 200 cows in the tie-stall operation. At the present time, the generation of bio-gas from the anaerobic digestion of dairy farm manures does not provide an alternate source of energy that is economically feasible in Vermont environment. Minimum unit costs for net available bio-gas ranged from $0.171 to $0.046 per kwh, respectively, for the 20 cow and the 200-cow dairy operations. (Ott-East Central)

### 3075 - A4, C3
### BACTERIOLOGICAL WATER QUALITY METHODS FOR DETERMINING RUMINANT FECAL POLLUTION,

Department of Microbiology, South Dakota State University, Brookings
P. R. Middaugh
Completion Report, South Dakota Water Resources Institute, Brookings, June, 1975, 56 p. 4 fig, 7 tab, 45 ref.

Descriptors: Water pollution sources, Farm wastes, Pathogenic bacteria, Enteric bacteria, Livestock wastes, Microbiology, Bioassay, Indicators, Bacteria, Bioindicator, Water quality, Human diseases.
Identifiers: Ruminant fecal pollution.

Studies have been completed on development of microbiological methods for detection of farm animal waste pollution of lake and river water. To differentiate ruminant fecal pollution from domestic sources, the fecal streptococcus, *Streptococcus bovis*, which is reported to be unique in ruminants, was detected by specific selective methods and media. *S. bovis* cells are differentiated by their starch hydrolyzing ability. The method as developed utilizes a membrane filter, 0.45 micron porosity, to concentrate the *S. bovis* cells. In one method the membrane is placed on modified Kenner-Fecal Streptococcus agar in a 60 mm petri dish. An overlayer of 3 ml of 1 percent agar which contains 0.2 percent starch-dye complex, Remazol Brilliant Blue-R dye coupled to amylose starch, is placed on the membrane. The cells are incubated at 37°C in a moist chamber with an atmosphere of 75 percent $N_2$ and 25 percent $CO_2$ gas for 24 to 48 hours. Visible clear zones develop around cells containing amylose or starch hydrolyzing ability. A further development uses commercial Pfizer Selective Enterococcus agar medium (modified to exclude esculin and with added 2, 3, 5 triphenyltetrazolium chloride to pigment the colonies red). In this method the membrane filter carrying the S. bovis cells is overlaid with 3 ml of the modified PSE agar to which was added 0.2 percent amylose-azure dye to indicate starch hydrolysis after anaerobic incubation. The method has been evaluated by tests on lakes and rivers. A small number of related streptococci also hydrolyze starch. These are typical S. faecalis cells which are biochemically differentiated, if necessary. (Wiersma-South Dakota State University)

### 3076 - A2, A4, A7, A12, B1, B4, D1, F2
### PROCEEDINGS OF CONFERENCE ON FARM ANIMAL WASTES: "FARMER EXPERIENCES, CODES, GUIDELINES, RESEARCH PROGRESS, EQUIPMENT",

R. E. Graves, ed.
Proceedings of Farm Animal Waste Conference "Farmer Experiences Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972. 63 p.

Descriptors: Regulation, Legal aspects, Farm wastes, Equipment, Water pollution, Air pollution, Public health, Agricultural runoff, Confinement pens, Liquid wastes, Dairy industry, Waste storage, Drying, Irrigation, Lagoons, Wisconsin.
Identifiers: Waste management, Cost sharing, Land disposal, Ducks.

This conference focused on the proposed Wisconsin code on animal wastes, existing and proposed manure handling guidelines, farmer experience with various manure handling methods, and systems and equipment that industry has availed today. Conference objectives were: (1) To give farmers, industry, and public agencies who have pioneered new waste handling systems a chance to tell their story, (2) To review the contents of animal waste regulations proposed for Wisconsin and their implications, (3) To develop discussion of present and future guidelines for handling animal wastes, (4) To consider the adequacy of research, handling systems and equipment, and current programs for animal waste management, and (5) To further discussion and communication among individuals, groups and agencies who have an interest and concern in this area. (Merryman-East Central)

### 3077 - A4, A7, B2, B3, F2
### A REVIEW OF THE POLLUTION ABATEMENT SITUATION IN INDUSTRY, MUNICIPALITIES AND GOVERNMENT,

Acting Chief, Technical Services Office, Processing and Disposal Division, Office of Solid Waste Management Programs, U. S. Environmental Protection Agency
T. W. Bendixen
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 5-9.

Descriptors: Water pollution, Air pollution, Regulation, Liquid wastes, Solid wastes.

Mr. Bendixen reviews activities and programs of the Federal government related to pollution abatement. Among regulations reviewed are: (1) the Clean Air Amendment of 1970, (2) the Refuse Act of 1899, and (3) the Federal Water Pollution Control Act. Geographical coverage, variation in local conditions, varying assimilative capacities of water bodies and nature and interaction of pollutants complicate any attempt to accurately rank sources as to severity or to show trends of water pollution. However, using biochemical oxygen demand as the criterion, many people feel that industrial wastes are the largest source of organic water pollutants nationwide; then municipal wastes; then agricultural wastes. Environmental improvement is a task of all the people, and every segment of society, whether it be cities, towns, industry, agriculture, business or governmental activities. (Merryman-East Central)

### 3078 - A4, B1, F2
### A REVIEW OF ANIMAL WASTE REGULATIONS AROUND THE NATION,

Dane County Environmental Quality Agent, Madison, Wisconsin
D. G. Last
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February-9-10, 1972, p. 10-15.

Descriptors: Water pollution. Regulation, Design.
Identifiers: Animal wastes.

Modern agriculture contributes a variety of quality degrading substances to our waterways. In particular livestock operations have been singled out as being a threat to water quality. It may be noted that regardless of whether a state has a specific law governing animal waste storage, transport, or disposal, all states, since the passage of the Water Quality Act in 1965, are required by federal law to have approved water quality standards. Such standards list minimum acceptable BOD levels, bacteria counts, etc. for each water body. These standards can be used to bring about a cease and desist order against a livestock owner or operator. A number of states have gone one step further and enacted animal waste pollution legislation. Approximately 14 states have present or proposed laws dealing with feedlot construction and/or operation. Eighteen states and several provinces of Canada have or are proposing specific animal waste regulations. An inventory of the states having specific animal waste control regulations reveals a great deal of difference in the content of the regulations. Many of the animal waste codes contain in or outside the body of rules, some statement of purpose, intent, or objective. Nearly every code has a definitions section. Most of the rules contain information on water pollution abatement facilities. They establish a procedure for determining the need for such facilities, their design requirements, operation and upkeep. Another common feature of animal waste regulation is some form of permit system. The enforcement of the regulations may be handled either through a state natural resources commission or a state health agency. (Merryman-East Central)

### 3079 - A4, A7, F2

### POLLUTION ABATEMENT IN WISCONSIN, HISTORICAL DEVELOPMENT AND PRESENT STATUS,

Assistant Administrator, Division of Environmental Protection, Stevens Point, Wisconsin
O. D. Williams
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 16-20.

Descriptors: Regulation, Air pollution, Water pollution, Wisconsin.
Identifiers: Pollution abatement.

Mr. Williams traces pollution problems and attempts at pollution abatement from colonial days to the present, citing specific pollution problems and regulations. This is all done as background for speeches to come later which deal with the proposed Animal Waste Rules. (Merryman-East Central)

### 3080 - A2, A4, B1, B4, F2

### ANIMAL WASTE PROBLEMS NOW FACING THE DEPARTMENT OF NATURAL RESOURCES,

Chief of Industrial Waste Water Section, Department of Natural Resources, Wisconsin
P. P. Didier
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 21-28. 3 fig.

Descriptors: Regulation, Water pollution, Animal wastes, Wisconsin, Water storage, Waste disposal, Agricultural runoff.

The Wisconsin Department of Natural Resources' statutory authority and responsibilities in relation to water pollution and more specifically as related to animal wastes are reviewed. Various types of agricultural pollution are pinpointed. Manure management problems include: manure storage and disposal, the need for manure management alternatives, feedlot runoff, and livestock destroying banks of unfenced streams. Regulatory, advisory and cost sharing agencies must be coordinated to solve these problems. Any solution to the animal waste management problem will involve a mix of programs, combining regulation, research, education, financial assistance, voluntary actions by the farmer himself and even tolerance on the part of the non-farming population. (Merryman-East Central)

### 3081 - A4, A7, A12, F2

### LEGAL BASIS FOR ANIMAL WASTE REGULATION IN WISCONSIN'S WATER, AIR AND PUBLIC HEALTH,

Bureau of Legal Services, Department of Natural Resources, Wisconsin
J. Kurtz
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 29-31.

Descriptors: Regulation, Water pollution, Air pollution, Public health, Animal wastes, Wisconsin.

The proposed animal waste regulations of Wisconsin are the result of an ad hoc committee appointed by the Department of Natural Resources. The rules represent almost a year of work, representing an interdisciplinary approach. Before a hearing is held concerning them, the rules will be made available on a statewide basis to people that might be interested in them for review and comment. The rules will not be final and official until such time as the National Resources Board votes by a majority vote that the rules are to be published in the Administrative Code, and then they will be effective upon publication. The code is looked upon as a state of the art for handling agricultural wastes and applying them to the land at various times of the year; as the states advance, the requirements will advance. These requirements will not be imposed unilaterally; these requirements will be imposed by the hearing process. (Merryman-East Central)

### 3082 - A4, B1, B4, E2, F2

### PROPOSED ANIMAL WASTE REGULATIONS FOR WISCONSIN.

Professor of Soil Science, Wisconsin University, Madison
M. Beatty
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 32-36.

Descriptors: Regulation, Animal Wastes, Point sources, Agricultural runoff, Waste storage, Wisconsin.
Identifiers: Waste management, Water pollution control, Land spreading.

Background is given on how the ad hoc committee on agricultural waste pollution operated and how the animal waste rules were developed. Some of the major provisions of the rules are discussed. The rules begin with definitions of terms. The rules focus on water pollution. They give standards for systems of manure storage and handling. Plans for storage ponds and retention ponds must be reviewed by the Department of Natural Resources. The rules require plans for large operations, those that are greater than 800 animal units, to be submitted to the Department of Natural Resources for review. If manure is spread in the winter and no erosion control program is used, the spreading must be back a minimum of 200 feet from streams, lakes, ditches and ponds. The rules concentrate on point sources. Streams, lakes and ponds must be fenced out of the barnyards by 1975; and the runoff from animal lots and enclosures must be controlled so that the manure won't simply go under the fence and into a stream. A feedlot operator must have a minimum land area under his control for spreading of manure. One-third of an acre per animal unit for dairy, beef, swine, and sheep, and half an acre per animal unit for birds are the minimum areas suggested. The problem of odors is not dealt with due to their subjective nature. (Merryman-East Central)

### 3083 - B1, F2

### COMMENTS BY MEMBERS OF THE DNR ADVISORY COMMITTEE ON AGRICULTURAL WASTE POLLUTION,

G. Blaska, K. Kreul, M. Stellrecht, and R. Venable.
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 37-39.

Descriptors: Regulation, Animal wastes, Wisconsin.

Four members of the Advisory Committee, all of whom are Wisconsin farmers, served as a panel during a discussion of the "Proposed Rules". Prior to the discussion each man made a statement concerning the rules and his thoughts about them. Initial apprehension was expressed, but put at rest. There seemed to be a general consensus that the rules were at least a step in the right direction. (Merryman-East Central)

### 3084 - A2, A4, A7, B1, B4, D1, D2, D3, E1, F2

### DEPARTMENT OF NATURAL RESOURCES PROPOSED ANIMAL WASTE MANAGEMENT RULES,

Wisconsin. Department of Natural Resources. Ad Hoc Committee.
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 40-44.

Descriptors: Regulation, Waste storage, Waste disposal, Animal wastes, Waste treatment, Agricultural runoff, Wisconsin, Water pollution.
Identifiers: Inspection.

The Proposed Animal Waste Management Rules are given. The preamble states that when wastes from agricultural activities impair water quality, systematic prevention or remedial action is required. The proposed rules establish standards and define procedures whereby the state can protect the public interest in maintaining the quality of water in Wisconsin. The recycling of animal wastes to the land and the continued development of new and innovative systems are encouraged. Coordination of the efforts of regulatory, educational, technical, and financial assistance programs of other governmental agencies is also encouraged. Further technical development is necessary before rules controlling odors can be formulated. The Department of Natural Resources will continue to handle odor complaints individually and will promote further study of the problem. The rules will be periodically reviewed and, when necessary, revised to reflect the advancing technologies of agricultural production and environmental protection. Outlined in the proposed rules are: (1) Definitions, (2) Collection, storage and disposal of animal wastes, (3) Treatment of animal wastes, (4) Runoff control (animal shelters, enclosures and lots), (5) Filing of reports, plans and specifications, (6) Violations and enforcement, (7) Hearings, orders and appeals, (8) Inspection, (9) Limitations, (10) Severability, and (11) Applicability and effective date. (Merryman-East Central)

### 3085 - A1, B1, F1, F2

### SUMMARY OF TECHNICAL ASSISTANCE AND COST-SHARING PROJECTS IN WISCONSIN,

I. Bolstad, J. Densmore, and M. Knabach
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 45.

Descriptors: Cost sharing, Wisconsin, Waste storage.
Identifiers: Pollution control, Rural Environmental Assistance Program, Lake Mendota Watershed, Soil Conservation Service.

The 1970 National Rural Environmental Assistance Program made provision to cost-share on pollution abatement measures. Diversions above and/or below the barnyard were the initial practices installed on approximately 100 Wisconsin farms. The special manure storage project in the Lake Mendota Watershed was offered statewide in 1971, resulting in cost-sharing on 109 facilities. Soil Conservation Service approval was required for all cost-shared projects as being in compliance with their standards. Accomplishments as of February, 1972, were the grading of 110 acres of barnyard and the construction of 26 miles of diversions, 3 settling basins, 3 detention ponds, 56 stacking facilities, 3 manure storage ponds, and 33 liquid manure tanks. (Merryman-East Central)

### 3086 - A6, A7, B1, D1, D2, D3, E2, E3, F1

### THE REVIEW OF RESEARCH PROGRESS IN MANURE MANAGEMENT,

Branch Chief, Livestock Engineering and Farm Structures Research Branch, Agricultural Engineering Research Division, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland
R. G. Yeck
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 46-52.

Descriptors: Livestock, Poultry, Hydraulic transportation, Waste storage, Aerobic treatment, Drying, Separation techniques, Costs, Fertilizers.
Identifiers: Waste management, Land disposal, Composting, Odor control, Refeeding.

Research concerning components of animal waste systems are summarized and discussed. Because animal manures are biologically active materials, they undergo continual changes. The role of the engineer and designer of livestock waste treatment facilities is one of controlling these changes. Hydraulic transport, land disposal, waste storage, composting, aerobic treatment, odor control, refeeding, drying, and solid-liquid separation are discussed. The beef slatted floor and pits systems appear to be adaptable anaerobic pits. The bulk of broilers are raised on deep litter. Storage is built into the systems, but odor, feather and dust nuisance problems as well as overnitrification of land, are possible if good judgment is not shown in managing the wastes. There are many alternative courses of action for managing animal wastes. All will require additional costs in production. Some cost offsetting returns may be realized through utilizing the wastes. Utilization as cropland fertilizer remains the most practical for the majority of livestock producers. (Merryman-East Central)

### 3087 - A6, A10, B1, B2, B4, D1, D2, D3, E2, E3, F1

### REPORT ON FARMERS EXPERIENCES WITH MANURE HANDLING FACILITIES,

Assistant Professor and Extension Agricultural Engineer, Wisconsin University—Extension
R. E. Graves
Proceedings of Farm Animal Waste Conference "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 53-57.

Descriptors: Waste storage, Liquid wastes, Odor, Ventilation, Separation techniques.
Identifiers: Waste management, Land spreading, Ducks, Swine, Flies, Oxidation ditch.

Descriptions are given of waste management methods tried by farmers at 8 different farms. The Allen Johnson Farm employed a storage facility for manure from 65 milk cows and runoff from a 75' x 105' paved barnyard. Storage,area was sufficient for 6 months. A tractor-mounted loader removed the manure to a spreader for field spreading. The Fair Peak Dairy Farm utilized a solid manure stacking system with a commercially available swinging elevator. The major problem with this system was clean out of storage. Dilution by additional water yielded a material too thin to scoop and too thick to pump. The Kenver Farms used a conventional liquid manure handling system. The manure storage tank that was built was not adequate. Odor, flies, and the time required to scrape the barns were also problems. The Klug Farm employed an inexpensive solid manure storage structure with 6 months storage. The storage area was formed with earth walls. Crushed rock limestone 8-10 inches thick was used to line the entire structure. A perforated pipe inlet located in the low corner directed liquids that leached from the manure to a plastic lined retention pond. The Blue Mound Farm utilized a manure drying facility to obtain dried pulverized manure which was either bagged for sale or handled in bulk. The Hawkins Farm employed a confinement feeding operation with cold slatted floor barns. Manure storage was provided by six 30' x 30' x 8' tanks below the slats. Pits were emptied by a high pressure chopper type pump through an irrigation system. Irrigating required little labor or investment, but problems occurred with flies, odors and pit ventilation. The Pride Seed Co. Research Farm utilized an oxidation ditch beneath a slatted floor building to handle manure from a 24 sow and nursery unit. Overflow went to a holding basin. Material was removed from the ditch or holding basin by a vacuum liquid manure tank. Major problems were odor and foaming. The C and D Duck Farm directed its efforts to handling and eventually disposing of its concentrations of manure and water. A liquid handling system utilizing mechanical screening and settling to remove solids followed by aeration and chlorination of the water was considered. (Merryman-East Central)

### 3088 - B1, B2, B3, B4, E2

### REPORT ON EQUIPMENT AVAILABLE FOR MANURE MANAGEMENT,

Professor and Extension Agricultural Engineer, Wisconsin University - Extension
T. Brevik
Proceedings of Farm Animal Waste Conference, "Farmer Experiences, Codes, Guidelines, Research Progress, Equipment", Stevens Point, Wisconsin, February 9-10, 1972, p. 58-63.

Descriptors: Equipment, Waste storage.
Identifiers: Waste management, Hauling, Land disposal, Soil injection.

Slides were shown of newer equipment items related to storing, hauling from storage, and injecting into the soil. Companies represented were Starline, Inc., Harvard, Illinois; Badger Northland, Inc., Kaukauna, Wisconsin; Farmway Company, Marshfield, Wisconsin; Clay Equipment Corporation, Cedar Falls, Iowa; Pearson Brothers Company, Galva, Illinois; Patz Equipment Company, Pound, Wisconsin; Hedlund Equipment Company, Boyceville, Wisconsin; and Calumet Company, Algoma, Wisconsin. (Merryman-East Central)

### 3089 - B2, E2

### MANURE SYSTEM:FIVE YEARS OLD...GOOD AS NEW,

Successful Farming, Vol. 74, No. 6, p. D2, April, 1976.

Descriptors: Waste storage, Dairy industry.
Identifiers: Waste management, Land spreading.

In 1971, Gerald Robinson, Morrow County, Ohio dairyman, decreased waste handling labor demands by installing a pump system. When utilizing this system, manure is scraped into an opening at the lowest part of the concrete lot, which slopes from feeder and free stalls down to near the milking parlor. A utility sized tractor is used to blade manure across an opening where it drops into a pipe just ahead of the pump. Powered by a 7½-hp electric motor, the piston type pump quietly pushes the liquid manure through a 9-in. diameter vinyl pipe 250 ft. uphill underground to a large capacity 380,000 gallon dirt-sided lagoon. The pipe through which the manure is pumped goes into the bottom of the giant holding lagoon. Thus, the thick crust that forms atop the pit is left unbroken and seals off fresh manure odors as effectively as a tight fitting concrete slab. Since the pit holds 6 months storage, the manure is hauled and spread only when it's convenient. Spreading is done when there is no chance of runoff. Health inspectors have approved the system. (Ott-East Central)

### 3090 - A6, B1, C2

### IDENTIFICATION OF SULFUR GASES EVOLVED FROM ANIMAL MANURES,

Department of Agronomy, Iowa State University, Ames
W. L. Banwart and J. M. Bremner
Journal of Environmental Quality, Vol. 4, No. 3, p. 363-366, July-September, 1975. 5 tab, 17 ref.

Descriptors: Odor, Gases, Sulfur, Gas chromatography, Feedlots, Livestock, Aerobic conditions, Anaerobic conditions.
Identifiers: Identification techniques.

One major problem from the increased use of feedlots is the release of gases due to manure decomposition. Research on these gases has led to the development of gas chromatographic techniques. These techniques are used for direct identification of the gases. Manure from beef cattle, dairy cattle, swine, and sheep was studied. When incubated under anaerobic conditions, all manures studied released dimethyl sulfide, hydrogen sulfide, and methyl mercaptan and some released carbonyl sulfide and or carbon disulfide. Only trace amounts of one sulfur gas (dimethyl sulfide) was detected in the gaseous products of decomposition of manures under aerobic conditions, and no evidence could be obtained that sulfur gases contribute to the odors of dried manure. Most of the sulfur volatilized when manures were incubated under anaerobic conditions was in the form of hydrogen sulfide and methyl-mercaptan. The amount of sulfur volatilized in one month at 23 degrees C represented less than 1 percent of the total sulfur in the manures studied. (Talley-East Central)

### 3091 - A5, A8, B1, C2

### ALFALFA SAFEGUARDS GROUNDWATER,

Anonymous
Wallaces Farmer, Vol. 101, No. 5, p. 117, March 13, 1976.

Descriptors: Groundwater pollution, Nitrates, Crop production, Alfalfa.
Identifiers: Abandoned feedlots, Corn, Pollution control.

G. Schuman and L. Elliott found out that planting alfalfa in unused feedlots will prevent nitrate pollution of ground water. Nitrogen builds up in the top 5 to 6 feet of soil when feedlots are in use, but it is in a form that will not pollute ground water. But when feedlots are abandoned, this organic nitrate can be converted to a form that moves down through the soil with water. In a feedlot where 13.5 tons of total nitrogen per acre was found, corn took up 152, 265, and 81 lb. of nitrogen per acre. Corn was found less efficient than alfalfa in removing nitrogen from the soil. (Edwards-East Central)

### 3092 - B1, C2, D3

### PILOT-PLANT HIGH-RATE DIGESTION OF PIGGERY AND SILAGE WASTES,

Rowett Research Institute, Bucksburn, Aberdeen
S. Bousfield, P. N. Hobson, and R. Summers
Journal of Applied Bacteriology, Vol. 37, p. 1-2, 1974.

Descriptors: Anaerobic digestion, Waste treatment, Chemical properties.
Identifiers: Swine, Silage waste.

Anaerobic digestion of waste from pig fattening houses was shown to be possible using 15-liter heated (35 degrees C) stirred digesters loaded once daily, but a 100-liter digester mechanically loaded every five minutes proved more efficient. Pump capacity limited total solids (TS) input to around 4-5 percent with no sign of digester failure and maximum solids input should be considerably higher. Less than 2 percent solids caused washout. Percentage diminutions in waste properties were similar at all loading rates and some average results were (percent reduction): BOD 80, COD 57, TS 43, VFA 79. Ammonia was unchanged or slightly reduced. Settling the output for 14-15 days gave a liquid with only 4 percent of original BOD, 9 percent of COD and 22 percent of TS. Digestion was stable and activity was restored after stoppages with or without heating of 6 weeks or more, or aeration of digester contents due to system leaks or maintenance. Gas production (65-70 percent $Ch_4$, remainder $CO_2$ ) at 35 degrees C averaged 6.4 cu. ft /lb VS loaded; abrupt changes to 38 degrees C or 40 degrees C did not appreciably alter gas production: change to 30 degrees C lowered production, but over 8 days it returned to normal. Silage effluent was treated in a stable digestion with piggery waste. With about 10 percent (v /v) silage effluent added to piggery waste, the BOD input was up to 45,000 ppm compared with an average 10,000 ppm before, and COD was about 200,000 ppm compared with 50,000. The purification obtained (whole digester output) average (percent reduction): BOD 87, COD 61, TS 36, VFA 78. Gas output (69 percent $CH_4$, 30 percent C was increased by about 22 percent and shock loading of 30 percent silage did not upset digestion. (Abstract only; Abstract edited by Ott-East Central)

## 3093 - A6, A8, B1, C1, C2, C3, D3, E2, F3, F6
### STUDIES ON FARM LIVESTOCK WASTES,

Agricultural Research Council
Studies on Farm Livestock Wastes. London, Agricultural Research Council, 1976, 156 p.

Descriptors: Research and development, Slurries, Physical properties, Chemical properties, Biological properties, Biological treatment, Aerobic treatment, Odor, Separation techniques, Sludge, Crop response, Soil profile, Equipment, Waste storage, Pathogenic bacteria.
Identifiers: England, Land disposal, Anaerobic treatment, Dewatering.

This bulletin reviews findings from the 3-year research and development programs undertaken jointly by the Agricultural Research Council and the Ministry of Agriculture, Fisheries and Food. The bulletin was compiled by specialists who took part in these programs and it includes much unpublished work. It was compiled primarily for those engaged in research, development, and advice and gives substantiated scientific and technical information on the biological processes involved and their engineering implications. The emphasis is on treatment and use, with the conclusion that, whenever possible, all such wastes should be returned to the land. The bulletin concludes with reports of seven separate farm trials utilizing experimental treatment plants. Recommendations for future study are given. (Merryman-East Central)

## 3094 - A11, E3, F3, F6
### UTILIZATION OF PAUNCH-BLOODMEAL BY FEEDLOT CATTLE,

K. C. Byington
MS Thesis, Colorado State University, August, 1975, 46 p. 12 tab, 32 ref.

Descriptors: Feeds, Performance, Cattle, Nitrogen, Feedlots.
Identifiers: Refeeding, Blood and paunch meal, Cottonseed meal.

A project was undertaken to investigate the possibilities of using two by-products of the packing industry, dried rumen contents and blood meal (blood and paunch meal), as a substitute for vegetable protein in beef cattle rations. Blood and paunch meal was found to be highly insoluble and of superior amino acid make-up compared to cottonseed meal. A nylon bag trial indicated that approximately 60 percent of the nitrogen in cottonseed meal was liberated in the rumen compared to 35 percent for blood and paunch meal. Apparent nitrogen digestibility of blood and paunch meal was calculated to be 74.9 percent. A digestion trial was run using six Hereford steers to compare the ability of blood and paunch meal and cottonseed meal to support animal gains when used as the sole source of supplemental nitrogen. Cottonseed meal proved to be somewhat superior in promoting nitrogen retention. The differences were not, however, statistically significant (P less than .05). The results of the feeding trial indicate that substituting blood and paunch meal for cottonseed meal in the finishing ration increases gain and improves feed efficiency. Viewed from an overall standpoint, blood and paunch meal would appear to be most valuable in situations where essential amino acid availability is the factor limiting production. In addition to the fattening phase of beef production, the potential of blood and paunch meal seems to merit research into its applicability to other classes of livestock. (Cameron-East Central)

## 3095 - A4, B1, F1, F2
### HOW NOW BROWN COW: REGULATION OF FEEDLOT POLLUTION IN WISCONSIN,

C. E. Blackwell, III
Environmental Affairs, Vol. 3, No. 4, p. 769-789, 1974.

Descriptors: Feedlots, Pollution control, Wisconsin, Legal aspects, Water pollution, Point sources.
Identifiers: 1972 Federal Water Pollution Control Amendments, National Pollutant Discharge Elimination System.

Water pollution due to feedlot runoff has become a serious problem. Several legal steps are reviewed in this article which are (or have been) directed toward pollution abatement. Of major importance among such legal steps is the 1972 Federal Water Pollution Control Amendments. Section 402 of the 1972 Act establishes the National Pollutant Discharge Elimination System which has been utilized to reduce point source water pollution by feedlots. The Environmental Protection Agency (EPA), which was granted authority to administer the permit program established by this Act, has attempted to abrogate the effectiveness of the Act. This may be due to any or all of the following: (a) To include greater numbers of small feedlots would place an unacceptable economic and manpower burden on the EPA, (b) EPA pollution control efforts have been focused on urban sources of water pollution, and (c) The EPA is sensitive to criticisms from Agribusiness. While the major concern has been that strict pollution controls would cause economic dislocation, some sources such as David Blitzer (National Resources Defense Council), maintain that such controls would foster reorganization of the industry into larger and more efficient production units. The threat to water quality by agricultural runoff pollution cannot be dealt with in the manner employed to date. The problem can only be solved through the cooperation of federal, state, and local governments which, unfettered by self-interested pressure groups or concerns over administrative burdens, have the resolve and energy to obtain a high standard of water quality. (Merryman-East Central)

## 3096 - A4, A12, B1, C2
### STREAM QUALITY MEASUREMENTS ALONG A LIVESTOCK WINTERING OPERATION,

G. Hagfeldt
MS Thesis, Department of Agricultural Engineering, Montana State University, December, 1971, 61 p.

Descriptors: Water pollution, Livestock, Sampling, Measurement, Nitrates, Chlorides.
Identifiers: Wintering operations.

A project was conducted to develop instrumentation and techniques necessary for determining if animal wintering operations located along streams are polluters. The location of the test site was the Holmstrom Ranch located northwest of White Sulphur Springs, Montana. Through the winter of 1970-71, there were 1100 sheep, 243 calves, 85 hogs, and 185 cows wintered along the creek. Four water sampling stations were set up along the creek, 3 in the wintering area and a fourth approximately 4 miles upstream. Samples were taken periodically and the nitrate and chloride ion concentrations were recorded using a specific ion meter. Conductivity, sample temperature, stream flow, and weather conditions were also recorded. Nitrate and chloride concentrations were very small—much less than the upper limits allowed by the U.S. Public Health Service. Because the levels were so low, the actual concentrations could not be determined using the equipment and techniques available. Averaging all the readings taken over the project period did indicate that both nitrate and chloride ions decreased slightly along the wintering area. It was felt that more testing was needed to ascertain if these parameters did actually decrease, or if this was a result of the testing methods. (Ott-East Central)

## 3097 - A1 , B1, E1, E3
### MANURE MANAGEMENT RELATED TO SOIL, WATER & AIR—THE CHALLENGE TO AGRICULTURAL SCIENTISTS,

New Brunswick Department of Agriculture and Rural Development, Fredericton, New Brunswick
J. A. Roberts
Presented at Canadian Society of Agricultural Engineers Annual Meeting, Charlottetown, P.E.I., June 26, 1972, Paper No. 72-220, 6 p.

Descriptors: Waste management.
Identifiers: Manure, Canada, Land disposal, Refeeding.

A general discussion was given of the farm animal waste problem. The author presented and elaborated on three major challenges facing agricultural scientists: (1) to become involved in land use, economic, and systems planning; (2) to solve the problems of recycling livestock wastes; and (3) to make livestock production systems compatible with high density human populations. (McQuitty, Barber-University of Alberts)

## 3098 - B1, C2, E2
### LIVESTOCK WASTES AS A SUBSTITUTE FOR COMMERCIAL NITROGEN FERTILIZER,

T. Stucker and S. Erickson
Illinois Research, Vol. 17, No. 3, p. 10, 11, Summer, 1975. 5 tab.

Descriptors: Farm wastes, Nitrogen, Fertilizers, Costs, Livestock, Feedlots.

Because of the rise in commercial fertilizer prices, many farmers are either having to reduce fertilizer inputs or substitute relatively less expensive material, such as livestock manure, for the commerical fertilizers now on the market. Farmers may now find it profitable to consider livestock wastes as a substitute source of nitrogen rather than a supplement to commercial fertilizer. The nitrogen content of manure will vary according to animal sources, waste-handling system, and other factors. The total value to Illinois farmers of mechanically collected and distributed (nonpasture) swine manure handled by liquid and bedded solid systems is more than $4 million. Another consideration for livestock producers in times of soaring commercial fertilizer prices is the distances they can afford to haul livestock wastes. (Cameron-East Central)

## 3099 - B1, C1, C2, D2, E1
### PHYSICAL AND THERMOCHEMICAL PROPERTIES OF PIG MANURE,

Department of Chemical Engineering, University of Newcastle Upon Tyne, NE1 7RU, ENGLAND
Fuel, Vol. 52, No. 10, p. 302-303, October, 1973. 1 fig, 2 ref.

Descriptors: Incineration, Waste disposal, Waste treatment, Physical properties.
Identifiers: Swine, Thermochemical properties.

Pig manure presents severe disposal problems, and in the long term it is likely that incineration may prove the only acceptable solution. A series of tests was carried out in conjunction with a pig-feeding trial reported recently, in which densities, viscosities and calorific values of pig feces were measured with the development of a pilot-scale incineration in mind. The results showed relatively high caloric values which would contribute significantly towards reduced fuel costs in any combined drying incineration disposal operation. It will be seen that the high values obtained for caloric value go a long way toward promoting incineration as a viable commercial proposition, regardless of its probable ultimate necessity. (Cameron-East Central)

### 3100 - A4, B1, B2, C2, C3, E1, F2

### BASICS OF POLLUTION CONTROL,

Gurnham and Associates, Inc.
Basics of Pollution Control. Chicago, Gurnham and Associates, Inc., 1973, 44 p.

Descriptors: Dairy industry, Water pollution sources, Pollutant identification, Water pollution, Wastes, Industrial wastes, Wisconsin, Pollutants, Farm wastes, Waste water (pollution), Surveys, Flow measurement, Analytical techniques, Equipment, Sampling, Water analysis.
Identifiers: Seminars.

This text outlines the technical measurements used by pollution control technologists, as they apply to the dairy industry, and defines the technical terms used in federal, state, and local laws controlling waste water discharges from dairies. Sources of water borne wastes from dairies are listed, and the significance, loadings, and limitations for each and methods of analysis are described. A program for conducting a plant waste water survey, for the purpose of determining specific sources of pollution and measuring the quantities of each, is outlined. The appendix is a paper (by C. F. Gurnham and M. I. Beach) that explains the devices and techniques used for measuring flows and for sampling waste water streams. (Witt-IPC)

### 3101 - A6, A11, B2, D3, F3

### FLUSHING AWAY MANURE UNDER METAL SLATS,

R. Mercer
Good Farming, Western Edition, p. 12-14, March, 1974. 4 fig, 1 tab.

Descriptors: Confinement pens, Liquid wastes, Design criteria.
Identifiers: Swine, Flushing.

A flush system for manure disposal in confinement barns where total slats are installed has several advantages. The author discusses a system in an Ontario new weaner barn that takes pigs at the 15-20 pound range to the saleable weight of 45 pounds. The use of total slats has resulted in clean, dry hogs. The barn is almost odor free because the flush system is coupled with cross ventilation. Swine feet and leg problems are minimal. Feed loss is kept at a minimum with special feeders. The flush disposal system consists of 3 large tanks that are designed to dump their total volume of water when a specific level has been reached. The water used to fill the tanks is recycled. Two of the most important factors in a flushing system is water volume required and the slope of the gutter floor. A paper by Professor Hazen of Iowa is cited. Hazen summarizes the hydraulic flushing system in terms of the size of the area to be flushed, water velocity, flushing frequency, and the depth of the flushing stream. Professor Hazen then discusses the advantages and disadvantages of the hydraulic system. Design considerations for construction specifications, the positioning of the tank and the liquid requirements of a flushing system are given. Two areas of concern that still require research are disease transmission and control from anaerobic lagoons. (Penrod-East Central)

### 3102 - A8, A9, B2, B3, C2, E2

### THE RESIDUAL EFFECT OF HEAVY APPLICATIONS OF ANIMAL MANURES ON CORN GROWTH AND YIELD AND ON SOIL PROPERTIES,

West Central Experiment Station, University of Minnesota, Morris
S. D. Evans, J. M. MacGregor, R. C. Munter, and P. R. Goodrich
A Report on Field Research in Soils, Soil Series 91, Department of Soil Science, University of Minnesota, March, 1974, p. 98-110. 11 tab.

Descriptors: Crop response, Soil profile, Chemical properties, Insecticides.
Identifiers: Land disposal, Application rates.

Experimental treatments were arranged in 3 replications of a complete randomized block. Each plot was split into 2 parts of sub-plot treatments. Treatments of the main plots were : (1) No fertilizer or manure. (2) Recommended amounts of inorganic fertilizer each year (120 N + 40 $P_2O_5$ + 40 $K_2O$). (3) Solid manure from a conventional beef feeding facility (manure + straw) at 100 tons/acre (wet weight) in the fall of 1970 and of 1971. (4) Liquid beef manure from a slatted floor beef feeding barn at 284 tons/acre (wet weight) in the fall of 1970 and of 1971. Half of the sub-plots were treated at planting with insecticide for rootworm control. The plots were planted. Furadan at 10 lbs./acre was applied to the east 14 rows of each plot and the west 6 rows were left untreated. Starter fertilizer was used only on the fertilized treatment. Lasso was broadcast at 2¼ lb/acre; 2, 4-D amine at ½lb/acre was applied as a postemergence spray on June 5. The soils in each plot were sampled to a depth of 10 ft in the fall of 1970, to a depth of 4 ft in the fall of 1971, and to a depth of 10 ft in 1972. These samplings were done prior to manure application. Sampling results indicated that $NH_4$-N levels were all quite low and the levels in soils treated with manure were no higher than check or fertilized soils. $NO_2$-N levels were also very low and there were no increases due to manure applications. The $NO_3$-N in the top foot of the liquid beef manure plots was 20 times higher than on the fertilized plot. Levels on solid beef and liquid hog manure were also very high. With all manures, there was some movement of $NO_3$-N into the 9-10 ft. zone. Conductivity of a soil: water mixture was increased by all manure applications. Bulk density was significantly reduced by solid and liquid beef manure in the 6-12 inch layer. Though higher electrical conductivity was found in manure plots, plant growth was not affected. Chemical analyses of the 1972 fodder, grain, and root samples were made for N, P, K, Ca, Mg, Fe, Cu, zinc, manganese and boron. The levels of P, K, and Mg were significantly lower where insecticide was used. Plant yields and measurements were also determined for the various treatments. (Ott-East Central)

### 3103 - A8, A9, B3, C2, E2

### THE RESIDUAL EFFECT OF RATES OF SOLID BEEF MANURE ON CORN GROWTH AND YIELD,

West Central Experiment Station, University of Minnesota, Morris
S. D. Evans
A Report on Field Research in Soils, Soil Series 91, Department of Soil Science, University of Minnesota, March, 1974, p. 111-117. 5 tab.

Descriptors: Crop response, Chemical properties, Insecticides.
Identifiers: Land disposal, Application rates.

The main experimental treatments were arranged in 3 replications of a complete randomized block design. Each plot was split into 2 parts for sub-plot treatments. Main plot treatments were: (1) Recommended amounts of inorganic fertilizer each year (120 N + 40 P205 + 40 K20), (2) Solid beef manure at 33⅓ tons/acre (wet weight) in the fall of 1971, (3) Solid beef manure at 66⅔ tons/acre (wet weight) in the fall of 1971, (4) Solid beef manure at 100 tons/acre (wet weight); 33⅓ tons applied in the fall of 1971 and 66⅔ tons in the spring of 1972. Half the sub-plots received Furadan insecticide treatment for rootworm control. The plots were planted to Pioneer 3956A (corn) on May 10, 1973. Starter fertilizer was used only on the fertilized treatment. Lasso was broadcast at 2¼ lbs/acre on May 13; 2, 4-D amine at ¼lb/acre was applied as a postemergence spray on June 5; 2, 4-D ester at ⅓ lb/acre was applied on June 22. Corn leaves were collected from the insecticide treated portion of each plot in 1973 and analyzed. It was found that the 2 higher manure rates increased the leaf nitrogen levels. All manure rates increased leaf phosphorus and potassium levels. All manure rates decreased leaf magnesium and zinc levels. The lowest rate of beef manure was highest in leaf copper level. The other 2 rates were not significantly different from the fertilized treatment. At final harvest each year,grain samples were saved from all plots and analyzed. 1972 results revealed that all manure rates increased phosphorus, potassium, and magnesium levels in grain. It was also found that the use of insecticide brought about a slightly higher ear moisture content and higher yield. (Ott-East Central)

### 3104 - A8, A9, C2, E2

### MANURE RATE STUDY,

S. D. Evans, R. C. Munter, and P. R. Goodrich
A Report on Field Research in Soils, Soil Series 91, Department of Soil Science, University of Minnesota, March, 1974, p. 118-126. 7 tab.

Descriptors: Crop response, Chemical properties, Insecticides.
Identifiers: Land disposal, Application rates.

The main environmental treatments were arranged in 3 replications of a complete randomized block design. Each plot was split into 2 sub-plots—half of which received insecticide (furadan) treatment for corn rootworm control. The main experimental treatments were : (1) No manure or fertilizer, (2) Recommended amounts of inorganic fertilizer each year, (3) Solid beef manure at 10 tons/acre (dry basis) each fall, (4) Solid beef manure at 20 tons/acre (dry basis) each fall, (5) Solid beef manure at 30 tons/acre (dry basis) each fall, (6) Liquid beef manure at 19 tons/acre (wet basis) each fall, (8) Liquid beef manure at 57 tons/acre (wet basis) each fall. The plots were planted to Pioneer 3956A corn on May 10, 1973. Furadan was applied at 10 lbs/acre to half the subplots at planting. Starter fertilizer was used only on the fertilized treatment. Lasso was broadcast at 2¼ lbs/acre on May 13; 2, 3-D amine at ½ lb/acre was applied as a postemergence spray on June 5; 2, 4-D ester at ⅓lb/acre was applied on June 22. Manure was applied for the first time in the fall of 1972 for the 1973 crop. The soils in each plot were sampled to a depth of 10 feet in the fall of 1972 prior to manure application. In the fall of 1973 the soils were sampled to a depth of 8 feet. (Results are not yet available.) Leaf samples were taken at silking and fodder, grain, and root samples were taken at the silage stage. Samples were dried and analyzed. Manure increased the leaf content of nitrogen, phosphorus, and potassium and decreased magnesium and zinc levels. Manganese and boron levels were variable. Yield and plant measurements made in 1973 prior to harvest gave the following results. (1) Manure treated plants were tallest. (2) Root damage was reduced where insecticide was used. (3) In early September many plants died prematurely, apparently from stalk rot. Increasing amounts of manure resulted in more dead plants. There were also more dead plants in the artificially fertilized and the check plots. Insecticide reduced the percentage of dead plants. (4) Stalks broken above the ear were reduced by the insecticide. (5) Stalks broken below the ear in general increased where manure was used. (6) Ear moisture at harvest was quite variable. (7) The check or "no fertilizer" plot had the least grain yield. (Ott-East Central)

### 3105 - A2, A4, B1, E1, F2,

### NEW EPA PROPOSALS FOR FEEDLOT RUNOFF TAKE REASONABLE APPROACH,

R. D. Wennblom
Farm Journal Vol. 100, No. 1, p. G3, January, 1976.

Descriptors: Water pollution, Feedlots, Agricultural runoff, Regulation, Permits.
Identifiers: Point sources, Environmental Protection Agency, National Resources of Defense, Inc., Exemption.

The Environmental Protection Agency (EPA) is now taking a more reasonable approach to the possible pollution of streams by farm and feedlot runoff. Latest indication of this change in attitude came during a discussion of which size animal feedlots will require a wastewater permit. EPA Deputy Administrator John R. Quarles Jr. said that "EPA doesn't want to have to go out and regulate every feedlot. EPA has already prepared an exemption amendment and sent it to the White House for clearance before it goes to the Congress. Last March, in a suit brought by National Resources of Defense, Inc., (NRDC), the court ruled that the Corps of Engineers is responsible for all "the waters of the U.S.," not just the navigable waters. This decision gives the Corps authority over practically every natural and artificial body of water in the country, including farm ponds and streams where normal flow is 5 or more cubic feet /second. Next, NRDC challenged EPA's ruling that only the largest agricultural operations require a permit for the discharge of their wastewater into navigable streams. On June 10, 1975, the court ruled that EPA cannot exempt an animal feedlot or another agricultural operation simply because it's small. Forced to comply with this court order, EPA has now proposed new regulations to spell out the conditions under which concentrated animal feeding operations would be required to get a wastewater permit. Under EPA's latest proposals a permit would not be needed unless more than 1,000 slaughter and feeder cattle, 700 mature dairy cows, 4,500 slaughter hogs, 12,000 sheep or lambs, 55,000 turkeys, 180,000 laying hens, or 290,000 broilers are confined for 45 days or more during a 12-month period. Otherwise, a permit would not be needed unless "measurable wastes" are discharged directly into: (1) navigable waters that run through the feedlot; or (2) navigable waters by means of man-made pipe, ditch or flushing. A feeding facility, no matter what size, will require a permit if EPA and state authorities decide that it's a significant source of pollution. (Ott-East Central)

## 3106 - A11, B1, C2, D1, D2, D3, E3, F1

### THE ECONOMICS OF POULTRY WASTE FEEDING,

G. C. Masters
Egg Industry, Vol. 9, No. 6, p. 20, June, 1976. 1 tab.

Descriptors: Feeds, Performance, Economics, Cattle, Nitrogen.
Identifiers: Refeeding, Poultry wastes, Contaminants.

Three ways of processing poultry wastes to be used as cattle feed are dehydration, ensiling and chemical treatment. While dehydration is the most expensive on a per ton basis, the dehydrated form has been found to be easily transported and can be used in commercial feed meals. In contrast, ensiling requires less facility and operating costs, but the product is not as easily handled due to its moist form. A new chemical process called "Grazon" is now being used to treat animal wastes. The product is used on cattle waste, broiler waste and cage layer waste. The treated wastes are fed primarily to beef cattle. While all 3 methods destroy pathogenic organisms and improve palatability, there are dangers in feeding wastes. Any feed material, including animal waste, may be contaminated with hard metals and numerous other substances. Feeders must know their waste and run analyses to confirm levels of contaminants. Withdrawal periods can be used to reduce residue levels of some contaminants. Waste feeding, nevertheless, offers a fantastic financial opportunity for the poultry industry. (Merryman-East Central)

## 3107 - A4, B1, E1, F2

### EPA SETS FINAL RULES ON FEEDLOT PERMITS.

Wallaces Farmer, Vol. 101, No. 8, p. 42, April 24, 1976.

Descriptors: Regulation, Permits, Water pollution.
Identifiers: Environmental Protection Agency, Point sources, Animal units.

Final regulations that establish the conditions under which feedlots will need waste water discharge permits have been issued by the Environmental Protection Agency. It is estimated that about 3,240 livestock operations nationwide will need a permit under these regulations. In the final regulations, operations that do not discharge pollutants into navigable waters will not need a permit. But feeding operations will need a permit if there is a discharge of pollutants and their operations have more than 1000 slaughter and feeder cattle, 700 mature dairy cattle, 2,500 swine weighing over 55 lb., 500 horses, 10,000 sheep and lambs, 55,000 turkeys, 100,000 laying hens or broilers (continuous overflow watering), 30,000 laying hens or broilers (liquid manure handling), 5,000 ducks, or 1,000 animal units. An animal unit is a way to measure an operation that involves several types of livestock. A feedlot with 301-999 animal units will also need a permit if the facility discharges pollutants by means of a man-made conveyance or discharges into waters that pass through or have contact with animals. This includes operations larger than: 300 slaughter or feeder cattle, 200 mature dairy cattle, 750 swine over 55 lb., 150 horses, 3,000 sheep, 16,500 turkeys, 30,000 laying hens or broilers (continuous overflow watering), 9,000 hens or broilers (liquid manure handling), 1,500 ducks, or 300 animal units. This size feedlot may also need a permit if designated by the EPA or Department of Environmental Quality as requiring one. Livestock producers who will need a permit should file a short form B by September 1, 1976. (Ott-East Central)

## 3108 - B2, E2, F1

### ADVISED AGAINST LIQUID POULTRY MANURE SYSTEM,

Anonymous
Poultry Digest, Vol. 35, No. 412, p. 234, June, 1976.

Descriptors: Liquid wastes, Poultry, Economics, Waste disposal.
Identifiers: Waste management, Land spreading.

Herb Jordan, Pennsylvania State University extension poultry specialist, advises the poultry producer to avoid installation of a liquid system for handling poultry manure for the following reasons: (1) To get a tank full of dry manure taken out onto the field, you must haul 19 loads of useless water, because liquid manure is 19 parts water to one part dry manure. This causes a loss of $6,000 per year for the operation of a family-sized poultry farm. (2) Liquid manure can be toxic to crops if applied too heavily. (3) The majority of poultry farmers who get cited, called into hearings and fined for pollution are those with liquid manure systems. (4) Nearly all poultrymen who initiate liquid manure systems find that within 6 years they change from this system, or they go out of business, or they go bankrupt. (5) A liquid manure system always costs the poultryman many times more dollars than it brings into the farm family. (Merryman-East Central)

## 3109 - A7, A8, B1, C2, E2

### AMMONIA VOLATILIZATION FROM DAIRY MANURE SPREAD ON THE SOIL SURFACE,

Coastal Plain Experiment Station, Georgia University, Tifton
D. A. Lauer, D. R. Bouldin, and S. D. Klausner
Journal of Environmental Quality, Vol. 5, No. 2, p. 134-141, April-June, 1976. 6 fig.

Descriptors: Ammonia, Volatility, Dairy industry, Chemical properties, Fertilizers.
Identifiers: Land spreading, Surface spreading, Waste management.

An investigation was conducted to measure ammonia volatilization from dairy manure spread and left on the soil surface under natural field conditions. The ammonia volatilization was measured in 5 experiments carried out over a period of 2 years in spring, summer, and winter. Manure application rates were 34 and 200 metric tons /ha. Ammonia volatilization was determined after spreading by periodically measuring the total ammoniacal nitrogen (TAN) content of manure samples collected from the soil surface. Corrections were made for increase in ammoniacal N in the soil. Quantities of ammonia volatilized were large from dairy manure spread in the field. The mean loss of ammonia, excluding the January, 1974 experiment, was 85 percent on the total ammoniacal nitrogen spreading. Results indicated high probabilities of large quantities of ammonia volatilization from manure across a wide range of weather conditions. In general, 3 stages of ammonia volatilization from bovine manure can be hypothesized. The first stage is a very rapid initial loss of ammonia driven by very high $P_{NH_3}$ values resulting from urea hydrolysis in the manure. Half-lives of less than 1 day characterize first-stage losses. Second-stage ammonia volatilization losses, characterized by half-lives of 2-4 days, begin as manure is subjected to drying either in the facility or after spreading. The third-stage ammonia volatilization loss is characterized by a drop in $P_{NH_3}$ and rates exhibiting half-lives over 4 days. In order to insure maximum utilization of nitrogen in manure applied to cropland, management techniques have to be developed to minimize ammonia volatilization in the field and in the animal facility. (Ott-East Central)

## 3110 - A4, A6, A7, B1, F2

### BILL PROTECTS FARMS FROM NUISANCE SUITS.

J. Carlson
Wallaces Farmer, Vol. 101, No. 8, p. 41, April 24, 1976.

Descriptors: Regulation, Legal aspects, Iowa, Air pollution, Water pollution, Management, Odor, Feedlots.
Identifiers: Nuisance suits.

A bill (Senate file 367), currently in the Iowa legislature could help protect livestock producers from nuisance suits. One section of the bill says, basically, that whoever is there first is right. However, if the cattle feeder expands his operation and is then sued, he loses his protection and could be liable to the degree of his expansion. The producer's protection is good as long as he meets environmental regulations. The bill also tries to protect livestock producers from regulation changes. If a producer has to make a management change (one that costs less than 2 per cent of the cost of establishing the facility), to control an odor problem on a facility that's less than 10 years old, he has 2 years of exemption. If the facility is older than 10 years, he has a one-year exemption. If a producer is faced with a design change (one that costs more than 2 per cent of the cost of building the facility) for air quality on a facility less than 10 years old, he has a 10-year exemption from the change. If the facility is older than 10 years, he has a 10-year exemption from the change. If the facility is older than 10 years and he doesn't have a feedlot permit, the operator gets a 5-year exemption. If he has a feedlot permit, the length of his exemption from the change is the same as the time remaining on his feedlot permit. Exemptions from changes in water quality regulations are also included. A nonpermit holder would get an exemption of either 5 years from the change, or 10 years from when the facility was established, whichever is greater. A producer with a feedlot permit gets either 10 years from when the facility was built or the time remaining on his permit, whichever is greater. Senate file 367 says a feedlot should be exempt from both city and county zoning changes for 10 years from date of change. However, this doesn't apply to livestock operations currently within the city limits. This bill is currently under debate in the House of Representatives. (Merryman-East Central)

## 3111 - B3, C1, D1, E3, F1

### MANURE HANDLING SYSTEMS,

Poultry Science Department, The Pennsylvania State University, University Park
G. O. Bressler
Summary of talk delivered at London Poultry Industry Conference, London, Ontario, Canada, June 15, 1972, 6 p. 2 tab.

Descriptors: Drying, Economics, Costs, Moisture content, Physical properties, Recycling.
Identifiers: Dried poultry waste, Odor control.

A two-stage drying system was developed at Penn State which offers several advantages. It improves the physical characteristics of the manure and makes handling easier; it eliminates offensive odors; and the final product is felt to have more sales appeal. The two stages of the system are: (1) blowing air at high velocity over the manure, and (2) stirring the manure automatically 4-10 times daily. This system has been found to remove about 80 per cent of the water from the manure and to reduce the weight of the manure to be handled to about 1/3 the original weight before the manure is removed from the house prior to mechanical drying. The drying system has been found to be economically sound, with total costs for drying estimated at about $15/ton. Poultrymen who have adopted this system are finding ways to sell the product at a profit. New uses will be found for the product in the future. (Penrod-East Central)

### 3112 - A3, A4, C3
### BACTERIOLOGICAL QUALITY OF SURFACE RUNOFF FROM AGRICULTURAL LAND. PART II.

Department of Civil Engineering, South Dakota State University, Brookings
L. L. Harms, P. Middaugh, J. N. Dornbush, and J. R. Anderson
Water and Sewage Works, Vol. 122, No. 11, p. 71-73, November, 1975. 4 fig, 2 tab, 22 ref.

Descriptors: Agricultural runoff, Bacteria, Coliforms, Snowmelt, Water pollution.
Identifiers: Identification techniques, Fecal coliforms, Fecal streptococcus.

Density determinations of total coliform, fecal coliform, and fecal streptococcus in surface runoff from agricultural lands were found using the multiple-tube fermentation technique. The methods utilized for confirmation were brilliant green lactose bile broth for total coliforms, ethyl violet azide broth for fecal streptococci and EC medium at 45° C for fecal coliforms. Primary factors influencing the organism levels were: (a) source of runoff (snowmelt or rainfall runoff), and (b) ground cover conditions (ie, corn stubble, fall plowed, pasture, Brome or alfalfa, and oats stubble). Graphs and tables are given that correlate the finding to cognizable units. Rainfall runoff was found contaminated to pollution levels suggesting that runoff from agricultural lands may be a source of pollution for surface waters. The actual health hazard has not been determined. (Penrod-East Central)

### 3113 - B1, C2, D3, F6,
### THE KINETICS OF MICROBIAL NITRIFICATION AS APPLIED TO THE TREATMENT OF ANIMAL WASTE,

G. M. Wong-Chong
PhD Dissertation, Cornell University, June, 1974, 244 p. 49 fig, 26 tab, 134 ref.

Descriptors: Animal wastes, Waste treatment, Nitrification, Kinetics, Ammonification, Nitrogen, Nitrates, Bacteria, Temperature.
Identifiers: Reaction rates, Ammonium-nitrogen oxidation, Nitrite-nitrogen.

Two phases of experimentation were conducted. Phase 1 concerned ammonification, ammonium-nitrogen oxidation, and nitrite-nitrogen oxidation—the 3 steps for converting nitrogen to nitrate. Batch experiments were conducted using acclimated enriched cultures. Specifically sought were: (a) the nature of the reaction in each step and (b) the effects of environmental factors on reaction rates. Observations of ammonification by mixed cultures demonstrated the ability of the organisms to adjust to changes in substrate either by enzyme induction or by population change. Observations of the nitrifying organisms indicated that bacterial populations may also conform to population control mechanisms. Free nitrous acid inhibition of nitrification was observed. Phase 2 experimentation observed the reaction steps in sequence: firstly, ammonium oxidation to nitrate and secondly, conversion of organic nitrogen to nitrate. Experimental conditions were 20 degrees C with controlled pH levels and with ammonium sulfate as the ammonium-nitrogen substrate and a urea + casean mixture as a source of organic nitrogen. Cultures used were enriched, acclimated organisms grown in the laboratory and a ODML culture. It was found that reaction characteristics could be predicted by a system of simultaneous equations describing ammonification as a first order reaction and both nitrification reactions as zero order reactions. Lag periods were noted prior to the onset of nitrification. ODML culture experiments showed that the organisms made no distinction between urea and uric acid as organic nitrogen source. Ammonification rates were about 0.115 $hr^{-1}$. The ammonium oxidation step was the rate limiting stage in the reaction sequence if the nitrite accumulation was disregarded, because $k_3$ after ammonium depletion was always greater than $k_1$. The author concluded that in treating poultry waste, about 75 percent of the total organic nitrogen in the fresh waste was convertible to the inorganic form. Nitrogen loss occurred in reaction systems in which there was appreciable dissolved oxygen (0.5-1.0 mg 1.) (Penrod-East Central)

### 3114 - A11, B2, B3, C2, D1,D2, D3, E3
### UTILIZATION OF LIVESTOCK WASTES AS FEED AND OTHER DIETARY PRODUCTS,

Department of Agricultural Engineering, Illinois University at Urbana-Champaign
D. L. Day
Presented at the International Seminar on Animal Wastes, Bratislava, Czechoslovakia, September 28-October 5, 1975, 27 p. 10 fig, 12 tab, 22 ref.

Descriptors: Feeds, Drying, Nitrogen.
Identifiers: Refeeding, Livestock wastes, Dietary products, Wastelage, Oxidation ditch mixed liquor, Cereco, Corral, Grazon.

Livestock manure has historically been utilized for plant nutrients, soil builders, animal nutrients, and fuels. This paper discusses utilizing livestock wastes as nutrients in animal diets, commonly referred to as "refeeding." Properties of manure are influenced by such factors as ration fed, species of livestock and methods of manure handling, storage, and treatment. The amount of nitrogen in manure is of particular interest for refeeding because it is a major component of protein. Various methods of processing wastes for refeeding are reviewed as well as properties of the wastes that are of interest for refeeding. Probably the oldest method of processing wastes is the drying of poultry manure, with heated or natural air, and incorporating it into feed for cattle. Production of wastelage by collecting fresh manure from cattle feedlots, mixing it with hay, and ensiling the mixture is another method. Oxidation ditch mixed liquor (ODML) is a method of refeeding aerobically treated liquid wastes as a nutrient-rich drinking water. There are three major commercial methods of processing cattle wastes for refeeding in the U.S.A. They are the Cereco, Corral, and Grazon systems. The Cereco and Corral systems involve complex expensive equipment that limits their use to large feeding operations. Grazon can be used for small operations as well as for large ones. All the refeeding methods discussed include a process for controlling disease and odors and the methods range from simply mixing dried manure with new feed to complex waste processing schemes that yield several usable products including protein, vitamins, minerals, and water. The processed wastes are fed to the same and to different species of livestock. In all of the processing methods discussed except ODML, only about 40 percent of the wastes produced from confinement livestock can be refed to the same animals. The surplus must be utilized elsewhere. (Cameron-East Central)

### 3115 - A4, B1, C2, D1, E3, F1
### ELIMINATION OF WATER POLLUTION BY PACKINGHOUSE ANIMAL PAUNCH AND BLOOD,

Beefland International Inc.
Water Pollution Control Research Series, Environmental Protection Agency, November, 1971, 41 p. 15 fig, 10 tab, 6 ref.

Descriptors: Water pollution, Dehydration, Drying, Costs, Recycling, Cattle, Chemical oxygen demand, Biochemical oxygen demand, By-products, Chemical properties, Waste water treatment.
Identifiers: Packinghouse wastes, Blood, Rumen, Paunch manure, Feed additives.

The operation of two dehydrating machines, for the drying of cattle whole blood as well as paunch contents (rumen), at the Beefland International, Inc., slaughtering plant at Council Bluffs, Iowa, was studied. The BOD5 and COD of the blood and rumen were established. The mean BOD5 of the whole blood and rumen was determined as 156,500 ppm and 50,200 ppm, respectively. The mean COD of the blood and rumen was established as 218,300 ppm and 177,300 ppm, respectively. The economics of the drying process in costs per ton of dried product, per 1000 lbs live kill weight (LWK), and per animal were determined. The dehydrating costs per ton of dehydrated product were found to be $43.75 /ton for blood and $38.46 /ton for rumen. The average cost (blood and rumen) was $40.93 /ton. Laboratory studies were carried out on the dried whole blood and rumen with a view toward their actual and potential use as legally accepted feeds or feed additives. Percent moisture, protein, fat, carbohydrate, and other analyses of the dried products are reported. (Lowry-Texas)

### 3116 - A3, F4
### AGRICULTURAL RUNOFF - A BIBLIOGRAPHY,

Department of Interior. Office of Water Resources Research.
Water resources Scientific Information Center, WRSIC 72-204, January, 1972, 248 p.

Descriptors: Farm wastes, Water pollution sources, Bibliographies, Abstracts, Agricultural runoff, Information retrieval, Digital computers, Publications, Organic matter, Overland flow, Fertilizers, Drainage, Agricultural watersheds, Ammonium salts, Nitrates, Nitrogen cycle, Environmental effects.
Identifiers: Permuted indexing.

This bibliography contains 158 abstracts with full bibliographic details for selected reports, journal articles, and various documents published mostly since 1967. Produced from a computerized information base containing 25,675 abstracts at the time of search, the bibliography is representative of the information on agricultural runoff contained in the journal "Selected Water Resources Abstracts" through December 15, 1971 (Volume 4, Number 24). A significant descriptor index is given of representative weighted terms that best describe the information content of the abstracted items. A comprehensive index is also given that represents all descriptors and identifiers used to index the various papers and documents represented by the abstracts in the bibliography. Abstract items are arranged in ascending WRSIC Accession Number sequence. (Lang-USGS)

### 3117 - A4, C3
### PHYSIOLOGY AND NATURAL DISTRIBUTION OF THE BACTERIUM CARYOPHANON LATUM IN THE FRESH WATERS OF MISSOURI,

Department of Life Sciences, Missouri University, Rolla.
J. B. Hufham, R. Carroll, and J. Hill
Completion Report, Missouri Water Resources Research Center, November 8, 1972, 20 p. 4 tab.

Descriptors: Missouri, Water pollution, Pollutant identification, Ruminants, Ecology, Physiology, Water analysis, Microbiology.
Identifiers: Pollutants, Caryophanon latum, Fecal pollution.

An experimental selective medium was developed for use in quantitatively analyzing stream waters for the presence of the genus Caryophanon. The medium was based on yeast extract-peptone agar and incorporated high concentrations of streptomycin to inhibit growth of other microorganisms. Physiological studies with the organism, C. latum, showed a requirement which was met by using crude agar or an extract of crude agar. Resistance to sulfa drugs was also noted. The need to identify the nutrient or cofactor supplied by crude agar prohibits the final development and field trials of the medium. (Hufham-University of Missouri)

### 3118 - A2, A4, A5, A8, B1, C2, E2

### WATER QUALITY HYDROLOGY OF LANDS RECEIVING FARM ANIMAL WASTES,

Texas Water Resources Institute, Texas A&M University, College Station
D. L. Reddell, G. G. Wise, R. E. Peters, and P. J. Lyerly
Technical Report No. 50, Texas Water Resources Institute, June, 1973, 110 p. 23 fig, 26 tab, 61 ref.

Descriptors: Feedlots, Water pollution, Groundwater pollution, Agricultural runoff, Cattle, Chemical properties, Salts, Ammonia, Nitrogen, Nitrates, Texas.
Identifiers: Land disposal, Disposal rates.

A significant pollution potential from cattle manure has developed as a result of the cattle feeding industry progressing to large, high density feeding operations. The objectives of this study were to determine the characteristics of storm runoff from a beef feedlot and to evaluate the disposal of large amounts of manure on land. Feedlot runoff was found to carry large amounts of chemical elements. The concentrations of chemical elements did not vary with size and intensity of rainstorm as much as by topographic differences of the watersheds. More ammonia was volatilized from high pH soil columns than neutral pH soil columns. A total nitrogen loss of 10 to 20 percent occurred in the soil columns. Up to 900 tons / acre of manure can be safely plowed under 30 to 35 inches deep without creating a surface water pollution problem. An increase of salts in the groundwater occurred during the first year and then salts were reduced to initial values the second year. No nitrate pollution of groundwater occurred. Crops can be effectively grown on land receiving up to 900 tons / acre of manure. Peak yields occur the second and third year after plowing under. (Runkles-Texas A&M)

### 3119 - A5, A8, C2

### AN INVESTIGATION OF THE NITRATE PROBLEM IN RUNNELS COUNTY, TEXAS,

Texas Water Development Board, Austin
D. C. Jones
Environmental Protection Agency Technology Series Report No. EPA-R2-73-267, June, 1973, 214 p. 22 fig, 10 tab, 43 ref.

Descriptors: Nitrates, Texas, Water pollution sources, Groundwater pollution, Soil contamination, Chemical properties, Leaching, Remote sensing, Aerial photography.
Identifiers: Runnels County, Texas, Nitrogen isotope ratio, Infrared photography.

This report describes the investigation of nitrate contamination in Runnels County, Texas. It was found that most water well contamination is due to naturally occurring nitrate. However, all the very high nitrate contamination problems (more than 1000 ppm) are principally due to nitrate from barnyards. The nitrate sources were confirmed by utilizing the nitrogen isotope ratio technique. The nitrate contamination was caused by a rising water table which intersected and dissolved nitrate deposits from the soil. The rising water table was caused by a combination of low porosity aquifers, increased infiltration (decreased surface runoff) due to terracing, and several consecutive years of above normal rainfall. There appears to be no economical way to remove the nitrate from either the water or the soil. Recommendations for ways for the area residents to obtain potable water and for a continued monitoring program are included. (Environmental Protection Agency)

### 3120 - A1, A4, A7, A9, B1, F1, F2, F3

### AGRICULTURAL POLLUTION CONTROL AND ENFORCEMENT IN NEW YORK STATE,

Cornell University, Ithaca, New York
T. Flaim
Paper Prepared for the New York Assembly Scientific Staff-Study Performed in Cooperation with Department of Agricultural Economics, Cornell University, November, 1973, 27 p.

Descriptors: Farm wastes, Legislation, New York, Pollution control, Animal wastes, Sedimentation, Nutrients, Pesticide, Air pollution, Effluents.
Identifiers: Food processing wastes, Water quality standards.

The objective of this paper was to summarize briefly the research that has been done to date on the extent, magnitude, control and enforcement of agricultural pollution which would be of interest to New York legislators. Section II of the paper deals with the extent, location and types of agricultural pollution existing in the state. Section III deals with the various available means of abating pollution as well as new methods that might be developed through additional research efforts. Section IV examines the advantages and limitations of the commonly suggested methods of enforcement of agricultural pollution control. Section V analyzes the possible cost impacts of agricultural pollution control legislation. The findings of the study are summarized in Section VI, with conclusions drawn regarding further research needs and implications for policy-makers. (Flaim-Cornell University)

### 3121 - A11, B2, C2, D3, E2, E3

### DEMONSTRATION OF THREE RECIRCULATING SWINE WASTE MANAGEMENT SYSTEMS,

Agricultural Engineering Department, Iowa State University, Ames
J. R. Miner, T. E. Hazen, R. J. Smith, and G. B. Parker
Environmental Protection Agency Report No. EPA-660 /2-74-009, December, 1973, 147 p. 48 fig, 26 tab, 29 ref.

Descriptors: Waste treatment, Liquid wastes, Waste disposal, Hydraulic transportation, Lagoons, Irrigation, Odor, Chemical properties.
Identifiers: Swine, Waste water reuse, Land disposal, Aeration basin, Vibrionic dysentery, Flushing.

Three waste treatment systems were used to process liquid swine manure so the effluent could be reused as flush-water. Hydraulic transport was effective in removing manure from all eight buildings. Excess liquid from all three systems was applied to adjacent cropland to achieve nutrient utilization as the final disposal step. Reductions in building odors, manure handling labor, and land requirements for final effluent disposal were major goals of the demonstration. An aeration basin received the manure from two farrowing buildings with a capacity for 14 sows each. As anticipated, solids accumulated in the aeration basin. When the solids content exceeded 4,500 mg / l, plugging problems became frequent in the pump and piping system. A lagoon-aeration basin system served two farrowing buildings with a capacity for 28 sows each. The system performed adequately with only minor mechanical difficulties. A lagoon-RBC system served four finishing buildings with a total capacity of 700 hogs. Frequent mechanical and biological failure resulted in removal of the RBC from use. Lagoon effluent is being used to flush these buildings with success. Repeated outbreaks of vibrionic dysentery has prompted remodelling two of the buildings and flushing in a gutter covered with slats. (Environmental Protection Agency)

### 3122 - A11, B1, C2, D3

### EFFECT OF VENTILATION RATE OF BEEF CATTLE PERFORMANCE,

Professor, Agricultural Engineering Department, University of California, Davis
S. R. Morrison, G. P. Lofgreen, and R. L. Givens
Transactions of the ASAE, Vol. 19, No. 3, p. 530-532, May-June, 1976. 5 tab, 5 ref.

Descriptors: Ventilation, Cattle, Performance, Ammonia, Temperature, Gases.

A refrigerated air-conditioned barn at the Imperial Valley Field Station of the University of California was used for testing the effect of ventilation rate on beef cattle performance. Beef cattle in rooms with slotted floors over anaerobic manure pits were subjected to 3 ventilation rates: 8.8, 3.2, and 0.3$m^3$ / min per head. Feed intake and rate of gain were significantly higher at the highest ventilation rate for only the first 28 days. Manure gases were suspected to account for the differences. Ammonia concentrations were lower than those commonly thought to adversely affect cattle performance. (Rowe-East Central)

### 3123 - A6, B2, C2, D3, E3

### METHANE GENERATION FROM LIVESTOCK WASTES,

J. C. Lorimor and S. W. Melvin
Iowa State University Cooperative Extension Service Publication Pm-593, July, 1974, 4 p. 1 fig, 2 tab.

Descriptors: Methane, Anaerobic digestion, Livestock, Waste treatment, Gases, Odor, Nutrients, Design.

Advantages of methane generation in the treatment of animal wastes are: (1) Energy is harvested from waste which would otherwise be lost. (2) Odors which would otherwise escape and cause problems are contained in digestors. (3) Valuable nutrients are retained. Disadvantages are: (1) Digestors are expensive. (2) Anaerobic digestion is complex and sensitive to environmental conditions. (3) Digestion is not a disposal system. Anaerobic digestion is a two-part process, and each part is performed by a specific group of organisms. The first part is the breakdown of complex organic matter (manure) into simple organic compounds by acid-forming bacteria. These bacteria break down complex organics and produce primarily acetic acid and propionic acid, along with some ammonia, and carbon dioxide. The second group of microorganisms, the methane-formers, breakdown the acids into methane and carbon dioxide. In a properly functioning digestor, the 2 groups of bacteria must be balanced so that the methane-formers just use the acids produced by the acid-formers. If the acid-formers get ahead of the methane-formers, acids begin to accumulate, the pH drops, the methane-formers are inhibited, and ultimately digestion ceases. The balance of the 2 groups of bacteria is affected by several factors including loading quantity, quality, and frequency, as well as temperature, toxic elements, and pH. The gas produced is generally in the range of 60 percent methane and 40 percent carbon dioxide. An average of 10 cubic feet of gas may be produced per pound of COD or 12 cubic feet of gas may be produced per pound of volatile solids digested. When using the anaerobic digestor described, submerger inflow and outflow lines are needed to prevent gas from escaping. Either a mechanical mixer can be used or the liquid or gas can be recirculated for mixing. Flushing or scraping systems are well adapted because they can provide frequent waste removal and feeding. Disposal of the waste can be by hauling, dumping into lagoons, or pumping. Sludge must be periodically removed. For gas utilization, compressor and storage tanks are used, along with the associated plumbing which would include flame traps, pressure gages, regulator hydrogen sulfide scrubber, and pressure relief valves. (Ott-East Central)

### 3124 - A6, B2, B3, D1, E3, F1

### NO ODOR, NO WASTE: 'SUPER STRAINER' TAKES HOG MANURE WITH EASE,

Anonymous
Successful Farming, Vol. 73, No. 10, p. H1, September, 1975. 1 fig.

Descriptors: Waste treatment, Waste disposal, recycling, Separation techniques, Fertilizers, Solid wastes, Liquid wastes, Lagoons, Odor.
Identifiers: Swine, confinement pens.

A particular problem of the new giant sow complexes has been what to do with the manure. One such sow unit, North Central Pork Producers, Inc. of Clear Lake, Iowa, thinks it may have a solution to the problem. The corporation owners installed a manure treatment unit which acts like a giant, mechanical squeegee. All waste from the 6,000-head capacity flushes through 10- and 12-in. sewer lines to a 16-cu. -ft. concrete holding pit. A pump takes waste from the pit to a microstrainer. Brushes pass lightly across the screen on a revolving drum forcing the liquid through the screen. The strained solids brush to a horizontal auger which carries them to a vertical auger. The vertical auger has a squeezing action to remove as much additional water as possible. The solid then augers into a manure spreader. The strained liquid is pumped to a lagoon with overflow going to a second. The recycled water becomes the flushing agent in the facility. The unit removes approximately 90 cu. ft. of the solids per day and can process 75,000 gallons of manure. The cost of the unit is nearly $27,000 but the fertilizer value of the solid waste is expected to cover the operating cost of the unit. In this unit, by removing the large, solid particles before it goes into the lagoon, odor problems have been virtually eliminated. The solid waste will either be used as a crop fertilizer or bagged and sold commercially in garden shops. (Ott-East Central)

## 3125 - A11, C2, E3

## THE FEASIBILITY OF USING WASTE MATERIALS AS SUPPLEMENTAL FISH FEED,

Department of Fisheries and Wildlife, Michigan State University, East Lansing
J. D. Lu and N. R. Kevern
Progressive Fish-Culturist, Vol. 37, No. 4, p. 241-244, October, 1975. 5 tab, 10 ref.

Descriptors: Feeds, Performance, Nutrients, Fish.
Identifiers: Dried poultry waste, Sewage sludge, Refeeding, Catfish, Goldfish.

Since sewage sludge and dried poultry waste are high in protein, crude fat and carbohydrate content, a study was carried out to investigate the feasibility of using such waste materials as supplemental fish feed. The nutrient value of sewage sludge and dried poultry waste was tested on the growth rates of goldfish fingerlings and channel catfish fingerlings. A 30 percent sewage sludge diet was prepared by combining 3 parts sludge and 7 parts ground salmon feed. Three varying mixes for the DPW diets (30, 70, and 100 percent DPW) were prepared in much the same manner. In the goldfish experiment, 20 fish were placed in each of 3 tanks and were fed equal amounts equal to 3 percent of their body weight daily. One tank received salmon feed; one tank received the 30 percent sewage sludge diet; the other tank received the 30 percent DPW diet. In the catfish study, 18 fish were placed in each of 12 tanks. The tanks were separated into 3 groups of 4 tanks each. The first, second, and third groups of fish were fed 2 percent, 3 percent, and 4 percent of their body weight, respectively. Within each group of 4 tanks, fish were fed different types of diets: fish in the first, second, third, and fourth tanks were fed 0 percent (control), 30 percent, 70 percent, and 100 percent DPW diets respectively. Because of unequal initial weights, comparison of growth among different groups was based on the average monthly percentage weight gains for fish from each tank. Goldfish fed 30 percent DPW or 30 percent sewage sludge grew as well or better than controls. The average weight gain of control catfish in all 3 groups was greater than those in the experimental groups. Catfish fed on 100 percent DPW diets in all 3 groups showed little or no growth, and thus, were not included in the report. Growth results of control catfish in all 3 groups were significantly higher than those fed 30 percent or 70 percent DPW diets. Thus, the results from the experiment using goldfish appeared encouraging and results from the catfish experiment slightly less promising. Nevertheless, the concept of converting waste substances into usable materials is highly desirable. (Ott-East Central)

## 3126 - A6, A10, A11, B2, B3, D1, D3, E3, F5

## NO-WASTE FEEDING SYSTEM,

Anonymous
Progressive Farmer, Vol. 91, No. 7, p. 18-20, July, 1976.

Descriptors: Feedlots, Separation techniques, Design, Recycling, Lagoons, Methane, Carbon dioxide, Odor, Flies.
Identifiers: Waste management, Refeeding.

Don Kaplan of Bartow, Florida, has developed an innovative and efficient feedlot which has offset the factors which work against efficient feeding and finishing. Among these factors are: (1) Heat—Kaplan's feedlots use slotted roofs which create air drafts that keep the air moving and "cut the edge off" the sun. (2) High rainfall—The high open roofs protect the cattle. Slatted floors prevent belly-deep mud and allow collection and use of waste. (3) Flies and odor—Waste is removed every 2 hours, which greatly cuts down fly breeding and odor problems. Alleys are swept daily. (4) Lack of grain—Grain is received in bulk by train and truck. (5) Manure—Manure has been turned into a feed source. The animal wastes are handled in this manner. The wastes fall through concrete slatted floors to a concrete floor and are collected by an automatic scraper every 2 hours and pumped to an open holding tank. The contents of the holding tank are pumped to vibrating screens that separate undigested ground hay and other coarse solids. Water is added to wash the finer materials through the screens. The moist undigested feed is dumped onto a paved area beneath the separating screens. It is loaded into trucks, spraying with formalin, and stockpiled elsewhere on the paved area. It is later taken in trucks to the feed supply center where it becomes a feed additive. The liquid wastes that pass through the separating screens are pumped to a holding pond, the first in a series of 6 deep ponds and 3 shallow ponds. The first pond is anaerobic. The waste is further digested as it overflows into adjacent lagoons. The tenth pond is electrically aerated, and it and the final 2 settling ponds are used for raising tilapias which are harvested and sold. Water from the last pond is treated and returned to the feedlot for drinking water. A full-sized methane digester is under construction which will provide methane to the packinghouse and feedyard operation. Bartow is considering recovering carbon dioxide and converting it to dry ice. (Ott-East Central)

## 3127 - A12, C3

## RAPID METHOD FOR DETECTION AND ENUMERATION OF FECAL COLIFORMS IN FRESH CHICKEN,

U. S. Department of Health, Education, and Welfare, Public Health Service, Food and Drug Administration, Division of Microbiology, Cincinnati, Ohio
D. W. Francis, J. T. Peeler, and R. M. Twedt
Applied Microbiology, Vol. 27, No. 6, p. 1127-1130, June, 1974. 1 fig, 3 tab.

Descriptors: Poultry.
Identifiers: Fecal coliforms, Sanitary quality, Identification techniques.

A study was conducted to modify the rapid water fecal coliform procedure for use with foods and to evaluate it by comparing it with the Association of Official Analytical Chemists standard method for Escherichia coli. An agar pour-plate medium was formulated after intensive preliminary studies. This medium allowed the growth of fecal coliforms only, after 7 hours of incubation at 4.15 ± 0.05 C. Twenty-one samples of fresh, cut-up chicken were enumerated for fecal coliforms utilizing these 2 procedures. Verification of picked colonies was carried out in EC broth using parallel incubation temperatures of 45.5 and 44.5 ± 0.05 C. Verifications for these temperatures averaged 79 and 98 percent, respectively. All positively verified isolates were Escherichia coli types I and II, as were the negatives. Since the geometric means of the 2 methods were no more than 12 percent apart, it was felt that the method tested performed very well in comparison with the standard procedure. The rapid method showed value as a rapid screening procedure for the detection and enumeration of organisms indicative of fecal contamination of fresh chicken, and it appears to have potential application to other foods. Continuing studies are being directed toward evaluating the wider applicability of the rapid method for enumeration of total, as well as fecal, coliforms. (Ott-East Central)

## 3128 - A2, B1, F1, F2

## FEEDERS WARNED STATE, LOCAL RULES ON POLLUTION ARE COMING THREAT,

Anonymous
Beef, Vol. 12, No. 7, p. 11, March, 1976.

Descriptors: Regulation, Feedlots, Legal aspects, Permits, Agricultural runoff, Cattle, Costs.
Identifiers: Impact statements.

A recent report submitted by John Sweeten, Texas A&M agricultural engineer, to the American National Cattlemen's Association asserted that cattlemen must meet 2 criteria to head off environmentalists' pursuit of beef feedlot waste restrictions. Cattlemen must do a good job of preventing pollution from their operations and they must become politically involved. Sweeten told the ANCA that recently proposed rules concerning discharge permits were substantially influenced by the input of cattlemen. One area with which feedlot owners should become concerned is the construction of new beef feedlots. An EPA requirement that new feedlots file an economic impact statement could delay construction as much as 3 years. "Front end" costs such as hiring outside consultants for such construction are difficult to finance. There are 3 alternatives to filing an economic impact statement: (1) Congressional action to eliminate the requirement for an environmental impact statement, (2) Get states certified to issue permits, so the impact statements would not be required, and (3) Avoid being classified as a "new" source of pollution by staying under 1,000 head, buying an existing lot, or building plenty of runoff storage capacity. Sweeten also warned that cow-calf men are about to get their first exposure to EPA rules, as the federal government starts working on "non-point source pollution" which will eventually involve every non-feedlot cattle operation in the country. (Penrod-East Central)

## 3129 - A2, B1, F1, F2

## LAND APPLICATION OF WASTE MATERIALS,

Anonymous
Calf News, Vol. 14, No. 6, p. 28, June, 1976. 3 fig.

Descriptors: Organic wastes, Animal wastes, Nitrogen, Salts, Soils, Economics, Water pollution, Groundwater pollution.
Identifiers: Land disposal, Plant residues, Forest residues, Food processing wastes.

The Soil Conservation Society of America sponsored a national conference in Des Moines dealing with the application of plant and forest residues and animal and food processing wastes to the land. In one paper presented by Dr. B. A. Stewart of Bushland, Texas, Agricultural Research Station, the following points were made concerning the ability of the soil to accept manure: (1) Applications of manure and other wastes should be made in dry seasons to minimize water pollution and denitrification losses. (2) Salt is the limiting factor in areas with less than one inch percolation per year such as West Texas. (3) Nitrogen is the limiting factor in high percolation areas east of the Mississippi River. (4) Sandy soils with low-cation exchange capacity can receive less waste than soils high in clay or organic matter which have a high-cation exchange capacity. Though a number of papers were presented, Dr. John Sweeten of Texas A&M found the following common threads in all of the presentations: (1) A farmer or rancher is generally safe in applying organic wastes at rates that balance available nitrogen in the waste material with plant nitrogen requirements. (2) Most of our so-called waste materials provide economic benefits if used wisely for agronomic purposes. (3) There is a tremendous amount of technical information available on land disposal of organic wastes. (4) Practicing good soil conservation will automatically keep nearly all the organic matter, nutrients and pesticides out of streams and groundwater. (Ott-East Central)

### 3130 - B1, D3, E3
### ENERGY FROM AGRICULTURAL WASTE—METHANE GENERATION,

Department of Agricultural Engineering, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca, New York
W. J. Jewell
New York Agricultural Experiment Station, Cornell University, Agricultural Engineering Extension Bulletin 397, January, 1974, 13 p. 2 fig, 14 ref.

Descriptors: Energy, Methane, Anaerobic digestion, Recycling, Farm wastes, Design.

Of the several types of energy capturing processes available for converting animal wastes to fuel, anaerobic digestion seems most feasible for the majority of agricultural operations. Sufficient data have been developed to demonstrate that anaerobic digestion is capable of stabilizing most agricultural wastes while producing large quantities of methane. This concept has been widely applied in Europe during energy shortages and is presently used in India. However, large scale anaerobic digesters have not been used in American agriculture. The problems which would be created by installing and using such systems are not yet well understood. Research teams at Cornell and other institutions are attempting to determine the place of agricultural waste processing for energy conservation as well as pollution control. The feasibility of this approach should be clearly delineated within 2 years. Advantages and disadvantages of the anaerobic digestion process are outlined; operational limitations of anaerobic digester conversion of animal wastes to methane gas are stated; and energy equivalent of some common fuels in comparison to anaerobic digester gas are given. (Ott-East Central)

### 3131 - A11, B1, D1, E3, F1
### CONVERT HATCHERY WASTES INTO FEEDSTUFFS,

Department of Poultry Husbandry, University of Missouri, Columbia 65201
J. M. Vandepopuliere
Poultry Digest, Vol. 35, No. 412, p.247-248, June, 1976. 2 tab, 4 ref.

Descriptors: Poultry, Feeds, Dehydrating, Costs, Performance.
Identifiers: Hatchery wastes, Refeeding, Processing, Cooking.

Estimated hatchery wastes currently being produced in the United States are: broiler, 56,000 tons; egg-type chick, 20,000 tons; and turkey, 8,200 tons. Disposal of the wet mass from the poultry industry is expensive. Factors such as larger hatcheries, high disposal cost, increased feed prices and greater pressure on pollution make the possibility of processing poultry wastes a possible alternative. While processing equipment has not been designed specifically to handle poultry waste, in a few operations cookers that are normally used to process poultry by-product meal have been used to cook hatchery wastes. Experimental work has been conducted at the University of Missouri using a triple pass rotary dehydrator to process both types of hatchery waste. Processing costs would include such variables as quantity of waste, size of equipment, utilities, and labor. Each operation would need to conduct an economic analysis of processing poultry waste into a feedstuff. Hatcheries with a capacity of 150,000 eggs, operating 5 days per week, could expect to spend at least $40 to $50 per ton of hatchery by-product meal. To produce a high quality hatchery by-product meal, it is essential that the raw product be managed to prevent decomposition. The most desirable procedure would be to process the wastes on stream as the chicks are pulled. Collecting and storing the wastes for a limited period of time is discouraged. The basic research completed verifies that hatchery by-product meal can be utilized efficiently as a feedstuff by poultry. (Ott-East Central)

### 3132 - A8, A11, B1, C2, E2
### FEEDING SALT TO BEEF CATTLE,

California State Polytechnic University, Pomona
T. J. Cunha
Feedstuffs, Vol. 48, No. 20, p. 18, 20, May 17, 1976. 1 fig, 1 tab, 13 ref.

Descriptors: Cattle, Performance, Crop response.
Identifiers: Salt, Intake rates, Urinary calculi, Land disposal.

Salt needs for cattle are not always the same. Factors influencing salt needs are: (1) Kind of concentrates, pasture, hay or silage being fed. (2) The level of salt or other minerals in the water or in the ration being used. (3) The animal's life cycle stages. (4) Genetic differences in animals. (5) Growth rate, level of production, reproduction rate and level of milk production. (6) Temperature and/or humidity in the area. (7) The level of potassium in the ration. Salt deficiencies may be noted by changes in appetite, appearance and milk yield. Experiments have shown that cattle fed salt perform better and require less feed than those fed no salt. Research studies have shown that salt needs of beef cattle may vary from 0.9 to 0.5 percent in the ration. To be on the safe side, levels of 0.25 to 0.5 percent salt should be fed in the total ration dry matter. Also, cattle should be fed salt free-choice so they can eat more if the level in the ration is not adequate. It has been found that grazing cattle consume at least twice as much salt as those on dry feeds. Many large feedlots add 0.5 to 1.0 percent salt to feedlot rations because they feel the extra water consumption and increased urination caused by the higher salt levels help prevent urinary calculi. Research studies have not revealed harmful effects from the salt in the manure on soil or crops as long as the manure is applied at proper levels to the soil. (Ott-East Central)

### 3133 - A9, A10, B1, D1, D2, F1
### GOOD SANITATION STOPS STABLE FLY BUILDUP,

Anonymous
Wallaces Farmer, Vol. 101, No. 12, p. 23, June 26, 1976.

Descriptors: Feedlots, Insecticides.
Identifiers: Fly control, Sanitation.

Stable flies need to be controlled if cattle are to gain efficiently. Stable flies breed on manure and spilled hay and feed. Good sanitation is a must in controlling them. Sanitation tips are: (1) Scrape your feedlot if possible. (2) Pick up spilled feed outside the feedlot. (3) If possible, spread manure or move it where it can be tramped down. (4) Cover manure with tarps, and (5) Stack manure as far from cattle as possible. In addition to sanitation, insecticides can help control flies. Mist applications can be applied to the livestock. Residual insecticide sprays, which give longer fly control, may be applied to buildings, fences, walls, and posts or areas where flies rest. They should never, of course, be applied on cattle, feed bunks, or waterers. As most residual sprays last 10-21 days, they should be applied every 10-15 days during the summer and immediately after rainfall. Feed additives containing the fly control Rabon can be fed to cattle daily as a new method of fly control. Baits add another weapon to the fly control arsenal. Comparing methods, the mist blower is probably most expensive. A mist blower may cost $200 although treatments may be rather inexpensive. Other methods cost as little as 1¢ to 2¢ per head daily. (Ott-East Central)

### 3134 - B2, E2, F1
### LIQUID HAUL VS. LAGOON-IRRIGATION: THE BEST WAY TO HANDLE SWINE WASTES,

Swine editor, Successful Farming
R. J. Fee
Successful Farming, Vol. 73, Nov. 12, p. H2-H3, November-December, 1973. 6 tab.

Descriptors: Liquid wastes, Waste disposal, Costs, Irrigation.
Identifiers: Liquid-haul system, Lagoon-irrigation system, Land spreading, Swine.

Purdue University researchers in charge of the Baker Research Farm just completed a study of that 2,500 swine per year operation. They compared lagoon-irrigation systems vs. liquid-haul systems. Components of the lagoon-irrigation system were a liquid pit inside the building and a tile line which drained to an earthen lagoon. A sprinkler irrigation system pumped the waste from the lagoon onto the fields. Liquid-haul system components were a storage pit beneath the building and a 1,500 gal. vacuum tanker wagon. It was found that investment costs, annual operational costs, and labor requirements were lower for the lagoon-irrigation system than for the liquid-haul system. The researchers determined that the liquid-haul system appeared to be best for operations 2,500 head per year and less. The larger the operation, the more the balance would swing in favor of the lagoon-irrigation system. (Ott-East Central)

### 3135 - A11, A12, B1, C2, C3, E3, F2
### ANIMAL WASTES FOR FEED,

Feedlot Management, Vol. 18, No. 4, p. 36-37. April, 1976.

Descriptors: Feeds, Legal aspects, Toxicity.
Identifiers: Refeeding, Food and Drug Administration, Drugs, Pathogens, Heavy Metals.

A year ago, it seemed that the FDA was going to make a formal proposal advocating the use of at least some waste as a feed ingredient. But 2 FDA branches, the Bureau of Veterinary Medicine and the Bureau of Foods, argued over the details, and the questions raised were of sufficient concern to sidetrack the issue. Recently, BVM and Food committees have been trying to iron out the differences, dealing primarily with keeping out various toxic substances, drugs, pathogens, heavy metals, and other undesirable components. They have worked out a plan that would allow feeding waste to cattle not being finished for slaughter. All cattle fed waste would have to be taken off that feedstuff at least 60 days prior to slaughter, if they are intended for human consumption. Feeding waste to laying hens, breeder poultry, milk producing dairy cattle, and all poultry intended for human consumption would be prohibited. The agency estimates that 20 million tons of dry waste a year could be used in feed under the plan, compared with estimated U.S. production at about 1.7 billion tons. (Ott-East Central)

### 3136 - A4, A8, B1, C2, E2, F1, F2
### MANURE APPLICATION MERIT ANALYSIS AND CALIBRATION, TOO,

Agronomist, Nebraska University
L. Chesnin
Nebraska Farmer, Vol. 118, No. 4, p. 66, 68, 73, February 21, 1976.

Descriptors: Fertilizers, Economics, Cattle, Nebraska, Waste disposal, Legal aspects, Toxicity, Nitrogen, Salts, Copper, Arsenic.
Identifiers: Land application, Paunch manure, Nutrient analysis.

When commercial fertilizers became cheap sources of needed plant nutrients, interest in proper storage, handling, and application of animal wastes declined. Water pollution increased and was ignored until controls were required by federal and state agencies. Recent shortages of commercial fertilizers, along with the tremendous increase in their cost, has resulted in a new interest in proper storage, handling and application of animal wastes. Environmental controls have increased interest in proper disposal measures. The amounts of animal manures and paunch manure to be disposed of in Nebraska have led Nebraskans to take particular interest in the economics and environmental factors related to waste control. The value of application of manure to land as a fertilizer source has been recognized, but it has also been noted that the nutrient composition of the manures should be individually calibrated so that the land will suffer no detrimental effects from nitrogen, salt, or mineral buildups. Animal wastes vary greatly in composition with kind, age and health of the animal as well as the composition of the ration and method of handling the waste. Manures should be handled and stored to conserve nutrients for application to and immediate incorporation into the soil. (Ott-East Central)

## 3137 - A10, A11, B3, E2, F1

### RAISED BUILDING COMBINES SLATS WITH SOLID WASTE HANDLING,

Managing Editor, Feedlot Management
G. Ashfield
Feedlot Management, Vol. 18, No. 5, p. 607, May, 1976. 4 fig.

Descriptors: Solid wastes, Cattle, Economics, Performance.
Identifiers: Waste management, Slatted floors, Land spreading, Flies, Costs.

Two years ago, brothers James and Roger Holt of Delavan, Wisconsin decided to do something about muddy pens, less than optimal gains and high labor demand. They decided to reduce labor and to get the animals out of the mud with a non-liquid manure system. They built a slatted floor facility with 200 head capacity which would utilize the solid waste handling machinery already on hand. The building represents a perfect combination of slatted floor feeding and solid waste handling. The cattle produce 350 bushels of manure daily, which is enough to fill their spreader. During the summer months the ground level waste collection floor is scraped clean daily to minimize flies and the manure is hauled to nearby fields. During the winter, the collection floor is only cleaned about 3 times a week. It takes approximately ½ hour to clean the building. An additional 15 minutes is required for each round trip to the field with a load of manure. Labor requirements are further reduced with an automated feeding system. A feed bunk and waterers are located along a center section running the full length of the building. Construction costs on the building were $30,000, but that was 2 years ago. Today, the Holts estimate that the same building would cost 25 percent more, due to increased labor and construction costs. The 40 ft. x 80 ft. building was built to withstand a great deal more than normal stress. Walls are 10 in. thick with metal rods throughout for added support. The upper half of the building is of ribbed metal construction with eight sliding windows opening to give full ventilation during hot summer months. With prevailing winds from the north, the south side of the building is open and the roof on that side extends well beyond the building's edge. The roof has 1½ in. of styrofoam insulation. The new building seems to have no problems. (Ott-East Central)

## 3138 - A6, B1, B2, F2

### ODORS: THE NEXT BIG POLLUTION BATTLE,

B. George, C. Fulhage, and S. Matthews
Beef, Vol. 12, No. 8, p. 26-28, April, 1976.

Descriptors: Odor, Cattle, Legal aspects, Lagoons, Management, Feedlots.

Odor control is becoming very important to livestock owners because livestock operations are larger and more concentrated and because more non-rural people are moving into rural areas. State-imposed fines and civil suits may be avoided by: (1) Using proper management, (2) Responding promptly to a neighbor's complaints (3) Using common sense when picking a location, and (4) Utilizing good housekeeping techniques. Chemical treatments should not be totally relied upon. Treatments are usually needed at least once a week and after every rain. Lagoons, which have become popular around cattle operations, may create odor problems if not properly managed. A lagoon should be started by pumping it half-full of water before adding any manure to it. A new lagoon should be started in mid-summer. A lagoon should be diluted annually. About ¼ of the total volume should be pumped out and replaced with fresh water. A lagoon should be fed daily and should never receive a sudden, huge overload. Odors can be controlled; but, like all other parts of an operation, it takes management attention. (Ott-East Central)

## 3139 - E3

### SLUDGE, MANURE, AND GLASS WASTES ARE MADE INTO BRICKS: THREE TROUBLESOME WASTES BECOME A RAW MATERIAL SOURCE,

J. Rudestedt
Kemist Tidskrift, Vol. 84, No. 5, p. 36-37, May, 1972. 2 fig.

Descriptors: Recycling, California.
Identifiers: Bricks, Manure, Glass.

Processes have been developed in Californin for the economical conversion of dried manure, sewage sludge, and glass wastes into bricks. Glass-manure bricks are obtained from pulverized dried manure which has been treated to obtain a black powder similar to carbon black, and then mixed with pulverized glass (5 to 10 percent of treated manure to 90 to 95 percent of glass powder). The molded bricks are treated at low temperatures. The bricks thus obtained have densities ranging from 100 to 2,000 kg per cu m, are both gastight and flameproof, can be bored, sawed, glued and painted. They can be used for roofing, walls, waterproofing, or for water tanks. Odorless and flameproof bricks are obtained in another similar process from 50 percent dried and specially treated sewage sludge and 50 percent pulverized glass waste by applying heat and pressure treatment after molding. The density of such bricks is about 50 percent of that of customary bricks. The bricks to which pigments or metal chips can be added for decorative purposes before molding, can be used for wall and floor covering, and for bathrooms. (Solid Waste Information Retrieval System.)

## 3140 - A11, B3, C2, E3

### THE FATE OF RECYCLED URATE IN HENS FED ON A DIET CONTAINING DRIED POULTRY MANURE,

Agricultural Research Council's Poultry Research Centre, King's Buildings, West Mains Road, Edinburgh, Scotland
L. Martindale
British Poultry Science, Vol. 16, No. 4, p. 389-393, July, 1975. 3 tab, 8 ref.

Descriptors: Poultry, Feeds, Performance.
Identifiers: Refeeding, Dried poultry manure, Urate, Non-urate nitrogen, Non-protein nitrogen.

A quantitative examination was made of the fate of urate ingested in a diet containing 20 percent dried poultry manure (DPM). Seven colostomised hens were fed on a diet free of DPM and a diet including 20 percent DPM. The control diet (no DPM) was fed to all birds for 14 days followed by the DPM diet for another 14 days. Faeces and urine were collected only on the final 4 days of each treatment to allow the birds to equilibrate to the diets. DPM feeding was continued for a further 6 days for 2 hens which were given C-urate. Study results supported the view that urate is not available as a source of non-protein nitrogen for the chick and that the improvement of growth was due to the metabolisable energy content of DPM and to its non-urate nitrogen. The total daily urinary excretion of urate from the DPM diet ranged from 2.24 grams to 7.25 grams. Even the highest rate was probably less than the mean tubular secretory capacity ($T_m$ urate) of the kidneys. However, this parameter varies widely among birds and in some cases significant increases in plasma urate concentration may result from high intakes of DPM when excretion rates approach the $T_m$ urate. The specific activity of urate (µCi/g urate) in the final solution did not differ significantly from that found initially. Thus, results revealed that none of the urate present in DPM was utilized by the laying hen. (Penrod-East Central)

## 3141 - A4, B2, C2

### UTILIZATION OF ALGAL ASSAYS TO ASSESS THE EFFECTS OF MUNICIPAL, INDUSTRIAL AND AGRICULTURAL WASTEWATER EFFLUENTS UPON PHYTOPLANKTON PRODUCTION IN THE SNAKE RIVER SYSTEM,

U.S. Environmental Protection Agency, Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.
J. C. Greene, W. E. Miller, T. Shiroyama, and T. E. Maloney.
Water, Air and Soil Pollution, Vol. 4, No. 3-4, p. 415-434, July-August, 1975. 11 fig, 3 tab, 9 ref.

Descriptors: Water pollution, Algae, Nutrients, Sampling, Growth rates, Laboratory tests, Effluents, Waste water (pollution), Nitrogen, Phosphorus, Bioassays, Water pollution effects.
Identifiers: Snake River, Selenastrum capricornutum.

Industrial wastes, natural phosphate levels, irrigation return flows, municipal wastes, and the decay of aquatic biota contribute to high concentrations of nitrogen and phosphorus which stimulate aquatic growth and thick algal blooms in the Snake River system. Algal assays (Selenastrum capricornutum) were conducted on waters of 18 Snake River and tributary sites to (1) determine if algal growth was consistent with results predicted from review of chemical analysis for orthophosphorus and total soluble inorganic nitrogen; (2) determine if algal yields were eliminated by P, N, or some other nutrient essential to algal growth; and (3) predict the effect of N or P additions on algal productivity. (Klein)

## 3142 - A1, A4, A9, B1, E1, F1

### AGRICULTURE'S CONTRIBUTION TO THE SOLID WASTE PROBLEM,

720 Anderson Road, Davis, California
S. A. Hart
Water, Air, and Soil Pollution, Vol. 4, No. 2, p. 189-190, May, 1975.

Descriptors: Agriculture, Solid wastes, Water pollution, Economics.
Identifiers: Waste management, Pollution control.

Waste is a by-product of productivity. For every pound of beef produced, 25 lbs of manure is produced. Poultry is lower at only 8 lb / lb meat and fruit is even less at from 1 to 5 lbs of crop residue wastes left in the field for every pound of plant material for consumption. The same five steps are used in the management of agricultural wastes as those used in the management of any other waste commodity. The waste must be properly stored, collected, transported, processed, and discharged without degradation of the environment. Since the farmer doesn't willingly want to spend the money necessary for proper management, agricultural waste management is not always successfully completed. The most widespread, hazardous waste material, pesticides, is associated with agriculture. Although the crops are harvested and consumed, pesticide residues linger. Steps have been taken to alleviate the problem. This shows that as in other agricultural wastes, the technology exists to properly dispose of the waste. The reason the farmer doesn't utilize such technology is the economic expenditures associated with such technology. Only when the consumers demand a specific level of pollution control applied equally to all farmers will agriculture as a whole more properly manage its wastes. (Merryman-East Central)

## 3143 - A8, B2, C2, E2

### THE EFFECT OF SLURRY ON WATER PERCOLATION RATES IN SOIL,

Agricultural and Food Chemistry Research Division
Ministry of Agriculture for Northern Ireland.
I. S. Cornforth
Record of Agricultural Research, Vol. 21, p. 23-30, 1973. 4 fig, 3 tab, 14 ref.

Descriptors: Slurries, Percolation, Soil management, Soil microbiology.
Identifiers: Land application, Polysaccharides.

Laboratory experiments were performed to investigate the effects of cow and pig slurry on water percolation rates in columns of soil aggregates. It was found that slurry can decrease water percolation rates. So long as soils remained aerobic, microorganisms were able to remove organic matter restricting soil pores. Even if light applications of slurry were repeated frequently, there was evidence that after an initial lag period, organisms could prevent soil pores from becoming completely blocked. In sterile or anaerobic conditions, the effects of slurry were more marked. Organic matter accumulated near the soil surface, where pore blockage and water flow impediment most probably take place. Polysaccharides applied in the slurry were responsible for much but not all of the blockage of soil pores. It is reasonable to assume that heavy dressings of slurry applied to poorly drained soils or in very wet conditions may have a marked, and possibly persistent effect on soil physical conditions. If soil and climatic conditions allow the soil surface to dry periodically, the effects of slurry are not likely to persist, but if the soil surface remains permanently damp, slurry will probably intensify the already poor physical conditions in the soil. This effect may be decreased if the solids content of slurry is reduced by aerobic treatment. (Merryman-East Central)

### 3144 - B2, C1, C2, D3
### ENHANCED TREATMENT OF LIVESTOCK WASTEWATER II. ENHANCEMENT OF TREATMENT BY SOLIDS REMOVAL,

Research Assistant, Agricultural Pollution Control Laboratory, Department of Agricultural Engineering, Michigan State University, East Lansing
J. P. Harper, P. O. Ngoddy, and J. B. Gerrish
Journal of Agricultural Engineering Research, Vol. 19, p. 353-363, 1974. 5 fig, 7 tab, 9 ref.

Descriptors: Waste water treatment, Slurries, Cattle, Separation techniques, Aerobic conditions, Anaerobic conditions, Particle size, Liquid wastes, Solid wastes, Chemical oxygen demand, Nutrients.
Identifiers: Swine, Biological degration, Composting, Sand filtration.

An investigation was made of the theory that removal of suspended solids should improve the efficiency of aerobic or anaerobic treatment of the residual liquid fraction. Waste samples from cattle and swine were utilized. In each experiment, a composite sample was prepared and allowed to stand at room temperature for 24 hours. The composite material was then passed sequentially through U.S. Standard Tyler Screens to obtain the desired particulate size in the liquid fraction. The screen cake made up the solids fraction. Pollutional characteristics of the composite, component liquid and solid fractions were determined. A sand filter was constructed and used to filter screened waste to further reduce the particle size and suspended solids content. Degradation studies were performed by composting solid fractions and by aerobically and anaerobically digesting the liquid fractions. Conclusions drawn from the study were: (1) The solid fraction of screened waste is apparently stable in storage for extended periods of time. (2) Salt buildup in a water re-use system can be retarded by prior solids separation. (3) An enhanced rate of anaerobic removal of COD is observed for screened swine waste. (4) Screened swine waste water has a greater COD removal rate than that of cattle. (5) The aerobic removal rate of COD is superior in screened samples to rates reported for unscreened material. (6) Anaerobic pretreatment appears to cause a substantial improvement in the rate of subsequent aerobic digestion. (7) Particle size is the governing factor in the enhancement of treatment from screening. (8) The enhancement of treatment due to separation has a lower limit in particle size, i.e., there is an optimum particle size for treatment. This size is found in the no. 60 to no. 100 mesh region. (Penrod-East Central)

### 3145 - A11
### BOVINE VIRUS DIARRHEA,

Animal Disease Research and Diagnostic Laboratory, South Dakota State University, Brookings
M. W. Vorhies

NebGuide G75-243, Cooperative Extension Service, Institute of Agriculture and Natural Resources, University of Nebraska, Lincoln, July, 1975, p. A-8.

Descriptors: Diseases, Cattle, Infection, Viruses.
Identifiers: Feces.

Bovine Virus Diarrhea is a viral disease of the mucosal epithelial cells of the digestive and respiratory systems and associated regional lymphoid tissues of cattle. This virus is transmitted when it is excreted in the feces and discharges from the nasal, or oral mucosa of a susceptible animal and reproduces itself. After 1 to 3 weeks of incubation of the virus, an infected animal will usually have signs of illness. The virus can infect a fetus and its effect on the fetus will vary with the stage of gestation at the time of infection. This disease affects cattle of all ages, but younger calves are most susceptible. Clinical signs of illness are (1) fever, (2) depression, (3) anorexia, (4) diarrhea, (5) excessive salivation, and (6) lacrimation. The disease may progress rapidly with these symptoms: (1) dehydration, (2) cessation of rumenation, (3) severe conjunctivitis, (4) congestion and ulceration of the mucous membranes of the oral cavity. (Lameness may also occur in smaller animals.) From 1 percent to 10 percent of infected animals may fail to recover and may develop a form of the disease described as the mucosal disease syndrome. Symptoms are (1) severe dehydration, (2) failure to eat, (3) chronic diarrhea, and (4) progressively lose condition until death occurs. No treatment is effective against mucosal disease. (Edwards-East Central)

### 3146 - A9, A11, B1, F1
### FLIES SLOW GAINS: SPRAYING PAYS BIG RETURN, SAYS KANSAS LOT MANAGER,

Anonymous
Beef, Vol. 12, No. 10, p. 20-21, June, 1976. 2 fig.

Descriptors: Feedlots, Performance, Cattle, Economics, Spraying, Kansas, Management.
Identifiers: Flies.

The common housefly costs U.S. cattlemen millions of dollars each year. Although this scavenger doesn't feed on animals like blood-sucking varieties, it causes acute irritation and nervousness, keeping cattle restless during warm weather. This results in nervousness and weight loss. With a life cycle of 10 days or less, common houseflies multiply at breakneck speed. An average feedlot, maintaining minimum sanitary procedures, faces infestation levels of at least 5-6 flies per square foot through late spring, summer and early fall. The flies then reproduce into literally millions per acre. Migrating flies may also contribute to infestation levels. Fly control depends on 3 factors: good lot management, proper chemicals and drainage. To prevent fly caused energy conversion losses among his cattle, Les Keller bought an FMC 1229 air sprayer last year to help control his burgeoning fly population. His aim was to use a machine with enough reach to cover his pens with a fine mist, and yet have the power to penetrate manure piles, killing larvae. By wiping out early season flies, Keller was able to cut down his warm weather population levels dramatically. Texas Extension entomologist Bill Clymer gives the following recommendations for fly control. Feedlots should be designed to facilitate cleaning and prevent areas of continual waste accumulation. Removal of manure from under fence lines and spilled feed from bunk areas will eliminate important fly breeding sites. By stocking pens at heavy rates, maximum tramping will prevent fly larval development. Pens should be scraped clean shortly after removal of cattle as larval development may occur in 5 days. Observing these and other control hints along with a strong spraying program is paying dividends for many Western feedlots. (Ott-East Central)

### 3147 - A4. E1. F2
### FINAL POLLUTION RULES RELEASED,

Feedstuffs Washington Correspondent
F. Girres
Feedstuffs, Vol. 48, No. 11, p. 5, March 15, 1976

Descriptors: Water pollution, Feedlots, Regulation, Point sources

The Environmental Protection Agency has released its final regulation defining the conditions under which animal feeding operations are considered point sources of pollution and must obtain a wastewater discharge permit. Essentially the final regulation is a three-tiered definition that designates animal feeding operations as point sources of pollution according to size. Criteria for permit requirements are divided into 3 categories: for operations with 1,000 or more animal units; for operations with more than 300 but less than 1,000 animal units; and for operations with less than 300 animal units. The basic provisions of the regulation are: (1) Feeding operations with 1,000 or more animal units must obtain a permit if there is a discharge of pollutants into navigable water. (2) Feeding operations of 300-1,000 animal units are required to obtain a permit if the facility discharges pollutants through a man-made conveyance constructed for that purpose, or there is discharge into waters that pass through or comes into direct contact with animals in the confined area. (3) Feeding operations of less than 300 animal units do not require individual discharge permits. Feeding operations that fall into either of the latter 2 categories that do not meet the criteria for discharge permits may still be disignated point sources of pollution and require a permit if EPA determines that they are significant polluters. (Penrod-East Central)

### 3148 - B2
### FLUSHING GUTTERS FOR HOG BUILDINGS,

Agricultural Engineering Department, Cooperative Extension Service, Purdue University, Lafayette, Indiana
D. D. Jones, B. Horsfield, J. C. Nye, and R. George
Purdue Cooperative Extension Publication AE87, 1975, 30 p. 15 fig, 6 tab.

Descriptors: Design, Indiana, Guidelines.
Identifiers: Swine, Flushing, Gutters.

This publication is a design and operating manual for gutter flushing systems in hog buildings. The manual includes: (1) explanations of the system and how it works, (2) a basis for evaluating its potential for individual swine operations, and (3) guidelines to help develop a tailored system for individual swine producers. Worksheets, drawings, design tables and sources of additional information are included to aid in determining particular flushing system requirements. (Penrod-East Central)

### 3149 - A2, B2, B4, E2, F1, F4
### PREDICTING THE PERFORMANCE OF FEEDLOT CONTROL FACILITIES AT SPECIFIC OREGON LOCATIONS,

Water Resources Research Institute, Oregon State University, Corvallis
R. B. Wensink and J. R. Miner
WRRI Project Completion Report No. 34, Water Resources Research Institute, Oregon State University, Corvallis, August, 1975, 56 p. 3 fig, 10 tab.

Descriptors: Feedlots, Agricultural runoff, Legal aspects, Oregon, Computer models, Waste storage, Design, Economics, Climatology, Irrigation, Equipment.
Identifiers: Land disposal.

A mathematical simulation model was developed to size feedlot runoff retention reservoirs based upon previous climatological records. Two versions of the model were programmed. The first, called the return period design technique, investigated the results of employing EPA's performance standards as design criteria. The second model, entitled the sufficient design method, determined the minimum reservoir storage volume required to prevent illegal discharge as defined by the EPA Effluent Guidelines. The two techniques demonstrated that to use design procedures based upon a factor times the 10 year-24 hour or the 25 year-24 hour storm led to designs that were either unreasonably expensive or which led to illegal discharges for which the livestock producer was subject to monetary penalties. The sufficient design technique was also used to determine pollution control performance with various combinations of pumping rates and storage facility volumes. In some Oregon locations, the use of high capacity irrigation equipment allowed reduction of storage volume by over 45 percent; in other Oregon locations, due to precipitation patterns, no benefit was obtained from high capacity pumping equipment. (Wensink-Oregon State University; Merryman-Abstract editor)

### 3150 - B3, E3
### GROWTH OF INDIGENOUS ORGANISMS IN AERATED FILTRATE OF FEEDLOT WASTE,

Northern Regional Research Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Peoria, Illinois
B. A. Weiner and R. A. Rhodes
Applied Microbiology, Vol. 28, No. 3, p. 448-451, September, 1974. 2 fig, 1 tab, 12 ref.

Descriptors: Recycling, Microorganisms, Substrate, Liquid wastes, Fermentation, Aeration, Fungi, Yeasts.
Identifiers: Feedlot wastes, Flora, Nutrients, pH.

The liquid fraction of cattle wastes contains soluble and finely divided material potentially usable to microorganisms. A study was conducted to evaluate the ability of indigenous flora to grow under aerobic conditions in such liquid and to utilize the nutrients present. Filtrates from feedlot wastes were incubated in 9-liter aerated jar fermentors. One-third of the nitrogen and three-fourths of the organic material were taken up in 4 days. Acid was produced initially, but the aerated liquid rapidly became alkaline. With pH controlled at 7.0, a comparable pattern of carbon utilization occurred, but nitrogen was incompletely used. Maximal growth of organisms occurred at 48 hours, with gram-negative organisms representing ⅓ the total count of $3.5x10^{9}$/ ml. At 96 hours both total and gram-negative counts decreased sharply (82 percent) and then steadily diminished until numbers were nearly constant at about 20 days. Fungi and yeasts increased more slowly, and then they too decreased. (Penrod-East Central)

### 3151 - A4, A5, A8, B1, C2, E2, F1
### HANDLING DAIRY WASTES,

J. M. Rakes and O. T. Stallcup
Arkansas Farm Research, Vol. 23, No. 1, p. 14, 1974. 1 fig, 1 tab.

Descriptors: Dairy industry, Arkansas, Water pollution, Groundwater pollution, Costs, Nutrients, Salts.
Identifiers: Land disposal, Application rates, Fly control.

Most of the dairy manure produced in Arkansas is applied to the soil. This may result in nitrogen accumulation in surface or ground waters. The key to solving this problem is to incorporate the manure into the soil at such a rate that the proper amount of nitrogen is made available for plant utilization for forage and grain production. Two methods of manure handling are compared—scraping the manure into a pile and loading it with a front-mounted tractor loader and scraping it and then loading from a concrete ramp. Loading time was reduced 75 percent when the concrete ramp was used. It is estimated that the reduction in time and labor costs on a 35-cow herd would pay for ramp construction in 450 days, not including greater convenience, better manure utilization, fly control, and difference in machinery investment. In a study on incorporation of dairy lot manure into soil, manure was applied during October to a field of Boone orchardgrass and Victoria alfalfa. The field contained 3 types of soil. Rates of application were 100 tons and 10 tons per acre. Soil organic matter, potassium, sodium, and magnesium were found to be higher following application at the 100 ton per acre level, while calcium content was higher in the plots receiving 10 tons per acre. Nutrient levels on the 100-tons treatment area were not detrimental to plant growth. Neither was salt accumulation. It is believed that most dairy farms in Arkansas have enough land available to permit manure application or incorporation at a rate that would allow utilization of nitrogen without deleterious accumulation. (Penrod-East Central)

### 3152 - D3, E3, F1, F6
### HARNESSING 'COW POWER',

Lebanon County Field Agent, Pennsylvania Extension Service
D. A. Harter and D. L. Nelson
Extension Service Review, U. S. Department of Agriculture, Vol. 44, No. 11/12, p. 8-9 November/December 1973, 1 fig.

Descriptors: Recycling, Fuels, Methane, Anaerobic digestion, Energy, Organic wastes, Pennsylvania, Economics.

An untapped source of methane gas energy exists on farms almost everywhere in the United States. Methane gas has ⅔ the calorific value of natural gas and burns almost pollution free. Organic wastes from 100,000 cattle can service the needs of 30,000 people and with the energy crisis as it is, the low economy factor of methane gas production is quickly losing its importance. Cattle manure anaerobic digestors are commonly used in India as a power source. The idea to build and demonstrate a manure machine was developed by Don Harter, Area Resource Development Agent and chairman of the Environmental Committee for the 1973 Ag Progress Days. Don Harter obtained research data through a literature search of United States research on methane production and from the Gobar Gas Research Station in Ajitmal (U.P.) India. Using this data, Lebanon County Agent Glenn Miller and Assistant County Agent Newton Bair built a 30-gallon capacity digestor which uses a mixture of cow manure and water heated to 90 degrees. The builders exhibited the device to farmers at the 1973 Ag Progress Days sponsored in Lebanon County by Pennsylvania's Cooperative Extension Service. Ninety-eight percent of the farmers who filled out comment cards at the exhibit thought that further research was needed in the production of methane gas by anaerobic digestors. (Penrod-East Central)

### 3153 - A11, B1, C1, C2, E3
### REFEEDING WASTES TO BEEF CATTLE

W. W. Martin
Agricultural Research, Vol. 25, No. 2, p. 5, August, 1976.

Descriptors: Nutrients, Physical properties, Costs.
Identifiers: Refeeding, Cattle wastes.

High costs of feed and the desire to make use of wastes has led many people to consider refeeding wastes. The type of feed initially fed determines the value of wastes for refeeding. Wastes from cattle fed a low roughage ration usually meet the requirements for refeeding as a high-energy ration. When the amount of roughage in the original ration increases, the suitability of the manure for refeeding decreases. Dr. James Ellis of the University of Nebraska analyzed the manure composition of cattle fed low, medium, and high roughage rations. He found that the gross energy, crude fiber, protein, nitrogen, potassium, and other mineral elements were influenced by the roughage level. (Edwards-East Central)

### 3154 - B2, D3, E3, F1
### ANAEROBIC TREATMENT OF ANIMAL WASTES: A SURVEY,

Department of Animal and Range Sciences, Montana State University, Bozeman
J. C. Boyd
Research Report 65, Montana Agricultural Experiment Station, Montana State University, December, 1974. 13 p. 56 ref.

Descriptors: Waste treatment, Anaerobic digestion, Research and development, Design, Feedlots, Methane, Energy, Recycling, Separation techniques, Economics, Livestock, Poultry.
Identifiers: Refeeding.

In connection with a research project entitled "Animal Waste Stabilization", a survey was conducted to determine the present status of both the commercial application and the research effort on anaerobic treatment of animal wastes. Fifty state agricultural experiment stations were contacted. Forty-five replies, including those from two USDA Regional Laboratories and two commercial concerns, were received and are summarized. This survey showed only one commercial animal production unit to be using an anaerobic digester in a waste management program. Another unit is reported to be under construction in Canton, Georgia. A trench type anaerobic digester was found to be in the planning stages for use for a 100,000 head feedlot. This is an arrangement between Monfort of Colorado, Feedlot Division and Skelley B. Don and Associates of Denver in which Monfort Feedlots agree to supply the waste and to take back the digested sludge at a 50 percent moisture content. Four references to small family type digesters of 50 to 100 gallons capacity were mentioned in the responses to the survey. At least two concerns are offering services aimed at design and construction of such units. They are Les Auerback, 242 Copse Road, Madison, Connecticut and Biofuels Company, P.O. Box 609, Noxom, Montana. Twenty states have or are planning anaerobic treatment research. Research and development projects of various universities include: studying anaerobic digestion of some organic acids that are intermediates to the overall process, recovery of methane from anaerobic lagoons, anaerobic degradation of swine manure mixed with municipal digestion sludge, testing a fiber membrane which follows liquid-solids separation, kinetics and economic factors involved in the anaerobic digestion of livestock waste, and methane gas production problems in methane generation from chicken waste. (Rowe-East Central)

### 3155 - A8, A9, B1, C2, E2, F1
### NEBRASKA STUDIES METHODS TO USE WASTES IN FARMING,

Center for Rural Affairs, Walthill, Nebraska
D. Demmel
Compost Science, Vol. 17, No. 1, p. 31-32, January-February, 1976.

Descriptors: Fertilizers, Organic wastes, Nitrogen, Nutrients, Crop response, Insecticides, Salts, Costs.
Identifiers: Land disposal, Refeeding.

The December 10th Workshop, "Organic Residues and By-Products in Crop and Animal Production," was designed for both farmers and University and Extension Service staff members. The event was prompted by the rising interest shown for the return to crop rotations and greater use of organic farming methods. Dr. T. M. McCalla stated at the meeting that he prefers to call crop and animal residues "resources rather than wastes" because addition of organic matter makes the soil easier to till and gives it better water-holding capacity. Dr. McCalla also stressed that more research needs to be done concerning the symbiotic relationship of bacteria as a possibility for nitrogen production by corn or grasses. Dr. Howard Wittmus emphasized at the meeting that "crop residues are more important in erosion control than any other factor, including land terracing." Dr. Warren Sahs discussed research being initiated at the Mead Station to compare the use of legumes, rotations and manure with a conventional program of continuous corn using chemical fertilizers and insecticides. Dr. Terry Klopfenstein discussed the use and value of crop residue for cattle feed. In regard to animal manure as feed, he explained, "Refeeding manure to cattle is a possibility, but whether it is economical compared to its use as a fertilizer is yet to be seen." Dr. Conrad Gilbertson reported that swine manure has the best N value, about 7.5 percent, compared to dairy or beef and also is the driest and therefore requires less transport of moisture. Dr. Edwin Penas stated that studies in Scottsbluff, Nebraska, dating back to 1910, have shown the value of manures in returning nutrient depleted soils to original native N values. Dr. Leon Chesnin, soil chemist discussed manure loading on soils, saying one should "spread on as many acres as possible". He also emphasized that composition of animal waste can be controlled by what is fed. For instance, high salt rations will result in an alkaline soil over the long term. Dr. Glenn Helmers indicated that residue handling costs are rising and that one must look at the value of wastes and for the most efficient application methods. (Ott-East Central)

## 3156 - A11, C2, C3, E3
## NO ADVERSE EFFECTS FOUND IN DPW FEEDING TESTS,
S. Gross
Feedstuffs, Vol. 48, No. 26, p. 14, June 28, 1976.

Descriptors: Performance, Proteins, Nutrients, Diets.
Identifiers: Dried poultry wastes, Refeeding, Broilers, Pullets, Laying hens.

United Kingdom scientists have found no adverse effects in the refeeding of dried poultry waste (DPW) to poultry. Researchers at the Poultry Research Center, Edinburgh, Scotland, said that their studies utilizing DPW from caged layer hens revealed the DPW to contain about 30 percent crude protein, of which 1/3 was true protein and the rest was mainly uric acid. The true protein and amino acid content approximated that of barley and was fairly digestible. The DPW contained low levels of available carbohydrates, was a good source of calcium and phosphorus, and contained many trace elements at non-toxic levels. Bacterial content of DPW samples was low. Once the nutritive value of DPW was established, diets containing DPW, formulated on a least-cost basis, were fed to broiler chickens, replacement pullets and layers under commercial conditions. Broilers were fed starter diets containing 0 and 50 g DPW/kg and finisher diets containing 0, 50b, and 100 g DPW/kg, the true protein, amino acid, calcium and phosphorus content of the DPW being used in the diet formulation. The DPW had no adverse effects on growth, and efficiency of feed conversion was increased. A more severe test of DPW was carried out when light hybrid replacement pullets between 6 and 18 weeks old were given diets containing 160 g or 140 g crude protein/kg with or without 50 g DPW/kg. In this experiment, the ME, calcium, and phosphorus content of DPW was used in the diet formulation, together with the crude protein and not just the true protein content. The DPW again had little or no adverse effect on growth of the chickens. Diets containing 0, 100, and 200 g DPW/kg also were fed to laying hens of 2 strains and of ages between 18 and 70 weeks. In this experiment, the energy, calcium, phosphorus and true protein contents were used in the diet formulation. The over-all laying performance of the flock was poor, but hens given diets containing DPW performed significantly better than those fed diets without DPW. Mortality was reduced among hens fed the DPW-containing diets. DPW had no adverse effects on albumen quality, but shell thickness was reduced. (Ott-East Central)

## 3157 - D2, E3, F6,
## AMMONIA SYNTHESIS GAS GENERATIONS FROM CATTLE FEEDLOT MANURE,
Department of Chemical Engineering, Texas Tech University, Lubbock
W. J. Huffman, R. L. Peterson, and J. E. Halligan
Presented at Centennial ACS Meeting, Division of Fertilizer and Soil Chemistry, New York, New York, April 6-7, 1976, 27 p. 2 fig, 1 tab.

Descriptors: Gases, Fuels, Ammonia, Feedlots, Research and development.
Identifiers: Hydrocarbons, Ethylene.

Preliminary operational performance of a scaled-up version of a partial oxidation reactor for the production of ammonia synthesis gas (as well as hydrocarbons) from cattle feedlot wastes is presented. Current pilot scale data was found to confirm that an ammonia synthesis gas can be produced. Ethylene and other $C_2$ hydrocarbons potentially can be produced in the range of 50-180 lb per ton manure, depending upon operating conditions. The partial oxidation reaction of manure was studied at an atmospheric pressure over an approximate average reactor temperature range of 600 degrees to 800 degrees C. The cattle feedlot manure and air were the reactants in the partial oxidation, and steam was employed as a fluidizing medium. It was demonstrated that partial oxidation technology developed from a small scale reactor can be applied to a larger scale unit to produce an ammonia synthesis gas. The potential ammonia production is greater than 0.5 ton $NH_3$ per ton daf manure. It was also demonstrated that significant ethylene production can be achieved concurrently with ammonia synthesis gas production. Data also suggest that the upper limit on ultimate hydrogen production, total gas yield, or ethylene production per unit of dry ash-free manure feed has not been reached. (Merryman-East Central)

## 3158 - A8, E2,
## DRIED POULTRY MANURE REVEGTATES SPOIL BANKS,
Anonymous
Poultry Digest, Vol. 35, No. 413, p. 278, July, 1976.

Descriptors: Reclamation, Revegetation, Germination, Mulching.
Identifiers: Land disposal, Dried poultry manure, Application rates.

Application of 800 pounds of dried poultry manure per acre was used successfully in establishing ground covers on spoil and refuse banks located in the anthracite coal regions of Pennsylvania. Refuse banks were sprayed with a mixture of water, dried poultry manure, and seed, and then they were mulched. Fescue and birdsfoot trefoil were found to give the best results on flat ground, while vetch gave a better cover on slopes. It has been reported that up to 1,300 pounds of 5-2-2 dried poultry manure in 1,000 gallons of water can be applied per acre without salt content causing germination problems. (Rowe-East Central)

## 3159 - B2, B4, C2, E2, F1
## ECONOMICS AND TECHNOLOGY FOR CONTROLLING DAIRY FEEDLOT RUNOFF
Sanitary Engineer, U.S. Soil Conservation Service, Hyattsville, Maryland
R. L. Phillips and M. R. Overcash
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, June 27-30, 1976, Paper No. 76-4032, 26 p. 2 fig, 8 tab, 10 ref.

Descriptors: Agricultural runoff, Feedlots, Dairy industry, Economics, Technology, Costs, Soil types, Climate, Topography, Nitrogen, Irrigation, Waste storage.
Identifiers: Herd size.

Research objectives were: (1) Determine various design elements that should be considered in specifying a rainfall runoff pond for a dairy, (2) Prepare a field design, economic analysis, and operational recommendation for several dairy units representing 3 subregions in the Southeast, and (3) Assess the relative economic impact of compliance on a dairy and the impact of altering existing facilities or of building a completely new system. Factors affecting the cost of no discharge systems are: soils to be irrigated, climate, topography, building location and construction, herd size, crops irrigated, and method of harvest. Typical farms were studied on each of the following: (1) Mountain subregion — moderately shallow soils of ridges; (2) Mountain subregion — moderately deep and deep soils of broad valleys and basin; (3) Piedmont — firm clayey solid on felsic rocks; (4) Coastal Plains — loamy and clayey soil of smooth uplands, and (5) Coastal Plains — loamy and clayey soils of wet lowlands. These case studies revealed that the economic impact on the dairy farmer varies mainly with herd size and with yearly milk production. The cost of feedlot runoff control varies from 10 cents per hundred weight for large herds to 27 cents for small herds. Initial investment of controlling feedlot runoff ranges from $55-$154 per cow. Annual cost ranges from $12-$30 per cow, depending on herd size. Costs are highest for small farms. Building location and feedlot layout are the most important factors affecting cost. Nitrogen was found to govern the size of the irrigation disposal on all 5 study farms. Fixed area for disposal is the most economical. Climate has little affect on costs. Tripling storage capacity from 1 month's capacity to 3 month's capacity increases annual costs by one percent, but increased flexibility of management makes the increase worthwhile. (Rowe-East Central)

## 3160 - B2, C1, C2, C3, D3, F6
## OVERLAND FLOW TREATMENT OF SWINE MANURE LAGOON EFFLUENT,
Department of Agricultural Engineering, Oregon State University, Corvallis
J. O. Boda and T. L. Willrich
Completion Report WRRI-40, Water Resources Research Institute, Oregon State University, February, 1976, 149 p. 17 fig, 45 tab, 36 ref.

Descriptors: Overland flow, Waste water treatment, Pollution abatement, Lagoons, Anaerobic conditions, Waste treatment, Water quality control.
Identifiers: Swine, Anaerobic lagoons.

Effluent from an anaerobic swine manure lagoon was applied at the upper end of six, 100 feet long by 3 feet wide, grass covered plots which sloped about 3 percent. Objectives of this study were to measure concentration attenuation and mass reduction of potential pollutants in the wastewater as the result of overland flow, and to examine the influences of experimental variables on the effectiveness of the overland flow wastewater treatment process. Controlled variables included application rate and grass species. Seasonal differences in temperature, precipitation, and related physical, chemical and biological conditions were uncontrolled variables. Wastewater and soil horizons were sampled and analyzed at selected plot intervals, and plot runoff volume, air temperature, precipitation, and water table data were recorded. Amounts of wastewater applied to the experimental plots ranged from 2.0 to 10.8 inches per week. Grass cover on three plots was Alta fescue. The other three plots were seeded with redtop. (Water Resources Scientific Information Center)

## 3161 - A6, B2, B3, C1, C2, D1, E2, E3, F1
## ODORLESS BEDDING FROM MANURE WITH NEW SURGE TRU,
Anonymous
Successful Farming, Vol. 74, No. 9, p. 12, August, 1976. 1 fig.

Descriptors: Feedlots, Cattle, Recycling, Fertilizers, Liquid wastes, Solid wastes, Separation techniques, Costs, Odor, Design.
Identifiers: Bedding, TRU.

The new machine TRU (Total Recycling Unit), developed by Babson Brothers Co., processes regular free stall barn cow manure which arrives via valley scrapers and a storage pit, and leaves it clean and odorless. Material is pumped into the TRU, which turns it into 2 products: (1) an odorless solid material for bedding and (2) an easy-to-pump liquid fertilizer which retains nearly all of its nutrients. After the separating process, the remaining dry matter is down to 60 percent range in moisture and has no odor. The liquids can be used to fertilize fields by irrigation. Further testing is being done on the TRU. (Rowe-East Central)

## 3162 - B2, D3, E3, F1, F6
## METHANE GENERATION ON A FARM,

R. Wolf
Compost Science, Vol. 16, No. 5, p. 28-29, Autumn, 1975. 2 fig.

Descriptors: Methane, Recycling, Costs, Design, Biological treatment, Fertilizers.
Identifiers: Ecotope.

Ken Smith and Evan Brown of Ecotope, in response to the enquiries of the farm manager of Washington's State Reformatory Honor Farm, visited the farm and began the work on the idea of a large scale methane digester. After much study, a digester design was selected. Financed by a Washington State Department of Ecology grant, the digester is now under construction. The 2 main components of the system are two 50,000 gallon manure storing tanks from A. O. Smith-Harvestore. Because the high-rate digester system chosen requires constant mixing, a gas recirculation system has been chosen to facilitate the mixing. The drawback to such a system is that it requires energy to run the pumps to recirculate the gas. In operating the methane digester, manure will be gradually added and removed daily. With an average retention time of 17 days, maximum gas production will be achieved and the system will use all manure produced within a few days of production. The resulting digested slurry will have a higher available nitrogen content than the raw manure. The nitrogen will be in a form more usable by plants and without the pollution potential of raw manure. With increased nitrogen value, the farmer will not need to apply as much of the slurry to the fields to gain the same results as raw manure. Ecotope estimates the digester will transform about 8 tons of nitrogen a year or $6,344 worth of fertilizer. In addition, the conservative estimated gas production of 12,000 cu. ft. per day will be used to heat the creamery boiler at the farm. The value of the gas will be about $4,488. The system will cost slightly more than $100,000. (Rowe-East Central)

## 3163 - B2, E2
### WEATHER, RULES SEEN MAKING WASTE HANDLING IMPORTANT,
Feedstuffs editor.
J. D. Kendall
Feedstuffs, Vol. 48, No. 1, p. 16-17, January 5, 1976.

Descriptors: Liquid wastes, Waste storage, Irrigation, Weather, Lagoons.
Identifiers: Waste management, Tank wagon, Tanks, Storage pits, Land disposal, Knifing.

Geography and regulations are two factors that make waste handling important to dairy producers. Climate, particularly winter weather, is important when designing waste management and storage systems. Dairymen must be conscious of sanitary waste handling measures. Too large a container for wastes, whether tank, lagoon, or storage pit, can create problems. Solids may settle to such an extent that agitating won't get the job done. Also, too small a pump for a large basin may consume too much energy and labor before it will break up the crust. Two main problems occur when liquid waste disposal by means of irrigation is used: (1) having to move the irrigation pipes too often, and (2) putting too much of the liquid manure on the field. As an efficient means of disposal of liquid wastes, a tank wagon can put the wastes on any field on the farm. The same pump that agitates the lagoon or holding tank can also be used to pump the waste into the tank wagon. Knifing the liquid waste into the soil instead of broadcasting is more efficient in terms of corn fields because the knifing may be done after the corn is in — not when planting dictates. The tank wagon does have drawbacks. The 3,000 gal. tank and the tractor large enough to haul 3,000 gal. of liquid can easily make a wet field into a mass of ruts and ditches. The tank wagon is also hard to maneuver in close places. Until these problems are worked out, soil injection of cultivated crops will be stymied. (Rowe-East Central)

## 3164 - B1, E2, E3
### THE CLOSE-LOOP FOOD PRODUCTION SYSTEM: A NEW CONCEPT,
Associate Member ASAE
A. O. Leedahl
Agricultural Engineering, Vol. 57, No. 7, p. 33-35, July, 1976. 2 fig.

Descriptors: Recycling, Nutrients, Feeds, Fertilizers, Irrigation, Weather.
Identifiers: Closed-loop food production system.

An experimental closed-loop food production system has been developed in which plants and livestock are grown together in an environmentally controlled confinement housing system. Livestock are fed plant material unsuitable for human consumption plus processed livestock wastes. The growing plants utilize nutrients from livestock wastes—plus heat, moisture, and carbon dioxide given off by the livestock. Human food is provided by the fruits, vegetables, meat and dairy products and possibly from nuts, cereal grains, poultry and eggs produced. In this system, plants are grown in terraced beds on hillsides that face south. Coarse gravel or small rocks form the "soil" in which plants are grown. Nutrients are pumped periodically through the "soil" in the top bed. The solution flows by gravity to the rest of the beds and returns to a storage tank at the bottom of the hill. The solution provides all water and nutrients for the plants. Livestock feed is dispensed in bunk feeders. Livestock feed includes unedible portions of human foods, livestock wastes after supplementary treatment, and possibly forages. Advantages of the anticipated system are: (1) a relatively stable food and feed supply, (2) little, if any, pollution, (3) little, if any, outside irrigation water, (4) little, if any, added fertilizer, (5) utilization of most waste materials, (6) dramatic increase in yields per acre, (7) winter operation highly feasible, with little auxiliary heat even in the snowbelt, (8) operation much less dependent on the weather throughout the year. (Rowe-East Central)

## 3165 - A11, B3, C2, D1, E3
### VALUE OF DRIED POULTRY MANURE AND UREA AS PROTEIN SUPPLEMENTS FOR SHEEP CONSUMING LOW QUALITY TROPICAL HAY,
University of Zambia, Lusaka, Zambia
E. A. Gihad
Journal of Animal Science, Vol. 42, No. 3, p. 706-709, March, 1976. 3 tab, 17 ref.
Descriptors: Proteins, Feeds, Sheep, Hay, Performance.
Identifiers: Dried poultry manure, Urea, Refeeding, Digestibility.

A study of adding protein supplements to hay made from natural grass growing in Zambia, which is dominated by Hyparrhenia spp., was conducted with sheep. The protein supplements were soybean concentrate meal, poultry manure and a mixture or urea and molasses. The poultry manure used was dehydrated droppings obtained from caged hens. The soybean concentrate meal (SBM) and dehydrated poultry manure (DPM) were fed at the rate of 300 g /day and urea-molasses mixture (UM) at the rate of 350 g /day. Also, each animal received 600 g /day of hay. Hay alone was fed ad libitum as a fourth treatment for comparison. Each ration was fed to 8 sheep in a completely randomized design. The sheep were confined separately in metabolism crates, fed twice daily, and allowed free access to water. Fecal samples were taken and dried in a forced air drying oven for approximately 24 hours at 65 degrees C. The samples were composited and allowed to equilibrate with atmospheric conditions for at least 7 days, weighed, and ground. A representative sample of feeds was taken and ground for later analysis. Gross energy values to feeds and feces were determined by an adiabatic oxygen bomb calorimeter. Urine samples were also tested for nitrogen. It was found that protein supplementation increased dry matter intake. Acceptability to sheep of hay supplemented with DPM or UM was excellent. Rations containing 33.3 percent of DPM or UM were fully as good as soybean meal-containing rations. Balance and utilization values of nitrogen from DPM and UM rations were higher than those of SBM ration. Consequently, it was found that DPM and UM do have value as protein supplements for the high roughage tropical feeds. (Rowe-East Central)

## 3166 - B3, B4, C1, C2
### EFFECTS OF BEDDING ON MANURE DURING STORAGE,
Department of Agricultural Engineering, Cornell University, Ithaca, New York
J. Petersen, D. Ludington and R. Cummings
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-4567, 15 p. 4 fig, 2 tab, 12 ref.

Descriptors: Waste storage, Physical properties, Chemical properties.
Identifiers: Bedding, Deep pit system, Biological activity.

This study was conducted to determine the effect of bedding material on manure during storage in the deep pit system. This was accomplished by determining the mechanisms operating in the deep pit, and comparing pit operation at 4 different bedding application rates. The bedding application rate was described by the ratio of bedding applied kg. to the manure production of a standard size animal (450 kg) per day (units= kg/kg. c.d.) This system involved long term collection and storage and covered about 6 months. Animals used were bred dry cows and bred heifers. The study took place in a free stall dairy barn divided into 2 parts. Each half had a slotted floor, loafing area and feeding area. Each area was over a pit about 2 meters deep and 2 meters wide. There were 4 pits. Four different "applied bedding rates" (0, 0.68, 0.90 and 1.59 kg per cow per day) were selected. The bedding material, consisting of kiln-dried hardwood chips and shavings, was applied tri-weekly to the stalls along each side of the loafing alley and to the slats of the feed alley. Conclusions drawn from the study were: (1) Biological activity, moisture migration, and surface-air interaction operate in this system. (2) The use of bedding in the deep pit produces a response similar to that of composting. (3) Bedding acts as an aeration device in a deep pit system. (4) Four zones of bedding application exist. Loss is limited in the zones by oxygen availability, temperature, surface addition of material, and rapid moisture movement. (5) Results of the study apply to warm weather conditions and should not be applied to cold, weather operation. (Rowe-East Central)

## 3167 - B2, D3
### THE OXIDATION DITCH - PROBLEMS DUE TO SEDIMENTATION AND THEIR CONTROL,
Department of Agricultural Engineering, College of Agriculture and Life Sciences, Cornell University, Ithaca, New York
J. Martin, Jr. and R. Loehr
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, Cornell University, June 27-30, 1976, Paper No. 76-4030, 15 p. 5 fig, 2 tab, 17 ref.

Descriptors: Poultry, Hydraulic design, Sedimentation.
Identifiers: Oxidation ditch.

Aerobic biological stabilization of poultry and other animal manures has been shown to be an excellent method of odor control, waste stabilization, and nitrogen removal. The purpose of this study was to: (1) briefly outline the current hydraulic design approach for oxidation ditches, (2) describe the nature and effects of the sediment accumulations encountered, (3) analyze the deficiencies in the original design approach, and (4) propose changes to improve future oxidation ditch designs. The 2 oxidation ditches involved were located at Manocrest Farms, Camillus, New York. Each ditch received wastes from approximately 4,000 white leghorn laying hens. The birds were located directly above each ditch in two rows of stair-step cages. Both ditches were designed and operated at constant mixed liquor total solids (MLTS) concentrations. Following the completion of construction and equipment installation, oxygen transfer studies were conducted with tap water prior to commencement of operation under process conditions. The results of the study demonstrated that sediment accumulation in oxidation ditches can adversely affect process performance. These accumulations can cause the decrease of mixed liquor velocity to the point of cessation of flow. To prevent sedimentation, the design velocity for oxidation ditches should equal or exceed the scour velocity for the heaviest manure particles. Determination of equipment requirements to provide adequate mixed liquor velocity should be based on friction losses in the ditch channel. This approach should provide a more rational basis for oxidation ditch designs which will prevent sediment accumulations and related problems. (Rowe-East Central)

### 3168 - B1, E3, F1
### A ONE-BID BUYER!,

Beef editor.
P. D. Andre
Beef, Vol. 12, No. 11, p. 5, July, 1976.

Descriptors: Cattle, Performance, Feeds, Economics, Costs.
Identifiers: Refeeding.

Mississippian Ed McCaughn turns sorry auction market cast-offs into high demand baby beef. He buys a calf no matter if he has only 1 eye, is odd colored, walks a little funny, or has a hump or sway back. When they arrive on the farm, they are wormed and given an antibiotic shot for a total cost of about $2 per head and then turned out in pens with open sheds. They have to be given some shelter, but can never be over-crowded. The calves are given shots of vitamin A, D and E during the winter when it is cloudy. They eat a mixture of 12 to 15 percent corn, 60 percent broiler litter and 25 to 35 percent soybean stalks. Calves purchased in 1975 averaged about 200 pounds and cost less than $28 each. McCaughn kept them on feed for 165 days and they gained 2.25 pounds a day and were sold weighing 575 pounds for an average of 27 cents a pound. Each had received about $15 worth of corn. This means that a calf that costs $28 was fed for $15 worth of corn and sold for $155. (Rowe-East Central)

### 3169 - A8, B1, C2, F1
### BEEF FEEDLOT DESIGN AND MANAGEMENT IN MICHIGAN,

Michigan State University. Agricultural Experiment Station and Economic Research Service. U.S. Department of Agriculture.
Research Report No. 292, Michigan State University, Agricultural Experiment Station and Economic Research Service, U. S. Department of Agriculture, February, 1976. 31 fig, 22 tab, 29 ref.

Descriptors: Feedlots, Design, Management, Cattle, Economics, Costs, Michigan, Chemical properties, Legal aspects.
Identifiers: Housing systems, Pollution control.

Specific objectives of this study were: (1) evaluate the chemical composition of cattle manure as affected by housing system, and the nitrate and salt status of cropland to which manure is applied, (2) estimate the capital outlays, annual costs and energy usage associated with alternative technology-output levels for fed beef, and (3) appraise the economic impacts resulting from the possible imposition of selected pollution control measures. Fresh fecal samples and soil samples were taken from 6 Michigan feedlots utilizing different housing systems. Results indicated that the organic content of manure was highest for open lots, followed by drylots and total confinement systems. Nitrogen content was generally lower. Technological components considered were alternative housing, feed storage, ration and waste handling systems, along with alternative sex and animal types. Fuel consumption increased with the capacity of the feedlot for all technology combinations studied. Land requirements per cwt of beef produced were relatively constant for all technologies studied. Most economies of size that were found for labor, electricity, capital and annual production costs were realized at low capacity levels (250-300 head). Average costs were generally the highest, in terms of economic and energy items, with the open lot and lowest for the confined housing system. The average initial capital investment was also lower with confined housing because of higher feeding efficiencies and turnover rates. Capital economies of size can be attributed in large part to the unavailability of system components small enough to be fully utilized on the smallest lots. Labor economies of size can be attributed to: (1) larger equipment and (2) spreading management time over larger volumes. In considering the economic impacts resulting from stated pollution control measures that may occur in the future, it was found that the open lot feedlot was generally affected most and the confined housing feedlot least. (Rowe-East Central)

### 3170 - A6, B1, B2, E2
### PIT SCRAPERS EASE MANURE HANDLING,

J. Carlson
Wallaces Farmer, Vol. 101, No. 3, p. 49, February 14, 1976.

Descriptors: Odor.
Identifiers: Waste handling, Scrapers, Swine, Field spreading.

Pit scrapers are one means utilized by hogmen to alleviate the waste control problem. This method employs a scraper blade which is pulled inside a shallow pit under a slotted floor. The blade scrapes wastes to one end of the building. Winfred McCreedy, Washington County, Iowa, has utilized the pit scraper in his growing and finishing building for swine since January. The scraped wastes are dumped into a gutter and then flow into a lagoon. Odors are kept to a minimum. Ted Allen, Shelby County, Iowa, put a pit scraper in his growing and finishing building for swine in early June. In his system, the scraped wastes are dumped into a retaining pit and then pumped into a storage tank. This system cuts down on odor and allows Mr. Allen to hold the wastes before field spreading them. Both Mr. McCreedy and Mr. Allen agreed that, should the cable pulling scraper ever break, the slats above the shallow pit would have to be taken out to get to the problem. (Edwards-East Central)

### 3171 - A1, B2, E2
### ANIMAL WASTE MANAGEMENT FACILITIES AND SYSTEMS,

University of Tennessee, Knoxville
J. I. Sewell
Animal Waste Management Facilities and Systems, Bulletin 548, University of Tennessee, Agricultural Experiment Station, July, 1975, 47 p. 15 fig, 14 tab, 19 ref.

Descriptors: Research & development, Tennessee, Liquid wastes, Irrigation, Design, Water quality.
Identifiers: Waste management, Land disposal.

Tendencies toward larger animal production units, greater animal concentrations, needs to reduce labor requirements, and concern for environmental quality have led to much interest in the development of animal waste management systems. Since 1967, animal waste management research related to water quality liquid dairy manure systems, dairy manure slurry irrigation, slatted floor swine systems, slatted floor beef finishing systems, liquid poultry manure management systems, and waste applications on crop land has been conducted. This is exemplified by the work summarized in this publication. (Rowe-East Central)

### 3172 - A2, A6, B2, B3, B4, E2, F1
### WASTE MANAGEMENT FOR SLATTED FLOOR BEEF FINISHING SYSTEMS,

Professor and Associate Head, Department of Agricultural Engineering, University of Tennessee, Knoxville
J. I. Sewell, J. B. McLaren, G. D. Miller, J. E. Martin, and J. N. Odom
Animal Waste Management Facilities and Systems, Bulletin 548, University of Tennessee, Agricultural Experiment Station, July, 1975, p. 6-10, 1 fig, 3 tab.

Descriptors: Cattle, Performance, Liquid wastes, Costs, Agricultural runoff, Odor, Solid wastes.
Identifiers: Slatted floors, Storage pits, Field spreading.

An existing barn at the University of Tennessee Aluminum Company of America (ALCOA) Farm was remodeled to include aluminum slat and reinforced-concrete slat floors installed over manure collection pits in 14 pens. The already existing concrete slab floor was left intact in 6 pens. Study objectives were to develop waste management criteria, characterize the liquid waste produced, and monitor cattle performance. Liquid manure was removed from the pits by vacuum tank-spreaders and applied to crop or pasture land. Labor requirements for manure management from slatted floor and concrete slab floor systems were compared. Data were also collected on manure accumulation rates, manure agitation, and manure removal procedures. During the 3 years of operation, it was noted that: (1) Cattle on both types of slats were cleaner than those on slabs; however, no bedding was used on the slab. (2) Some slipping and falling occurred on all slats and slabs. (3) Slab pens were scraped and the manure was stockpiled until field disposal was feasible. Careful management was required to prevent water runoff and seepage from the stack. (4) Objectionable odors occurred when the pits were agitated and emptied, (5) Experimental aluminum slats incurred only minor mechanical damage during the first 3 years, but seemed to increase during the fourth year. (6) Slatted floors over collecting pits minimized manure drainage problems in the vicinity of the barn. Slatted floor systems were found to provide additional flexibility in scheduling waste removal. Problems associated with slatted floor systems were high facility investment, odors after spreading waste, and providing satisfactory environmental conditions for cattle during summer. (Rowe-East Central)

### 3173 - A6, A10, B2, B4, E2
### LIQUID MANURE SYSTEMS FOR DAIRIES,

Professor and Associate Head, Department of Agricultural Engineering, University of Tennessee, Knoxville.
J. I. Sewell, J. R. Owen, and J. W. High
Animal Waste Management Facilities and Systems, Bulletin 548, University of Tennessee, Agricultural Experiment Station, July, 1975, p. 11-15, 2 fig.

Descriptors: Liquid wastes, Dairy industry, Waste storage, costs, odor, Vectors.
Identifiers: Liquid manure pits, Land spreading.

In 1967, liquid manure holding pits were constructed at the Dairy Experiment Station at Lewisburg, Tennessee, and the Middle Tennessee Experiment Station at Spring Hill. Field studies were conducted at these sites to evaluate these liquid systems. It was found that liquid manure pits for dairy herds offered advantages in that manure storage was available during periods when field areas were not accessible, labor requirements were often decreased, and the scheduling of manure removal to better coincide with labor availability and field conditions was facilitated. With proper management, few agitation problems were encountered. Primary disadvantages of the systems were: land had to be available on which to spread the waste before the pit became full; odor and fly problems often developed immediately after waste was spread; and facility and equipment investments were high. (Rowe-East Central)

### 3174 - B2, C1, C2, E2
### LIQUID SWINE WASTE MANAGEMENT,

Professor and Associate Head, Department of Agricultural Engineering, University of Tennessee, Knoxville.
J. I. Sewell, and H. W. Luck
Animal Waste Management Facilities and Systems, Bulletin 548, University of Tennessee, Agricultural Experiment Station, July, 1975, p. 16-20, 3 fig, 1 tab.

Descriptors: Liquid wastes, Sampling, Nitrates,

Chemical Oxygen demand.
Identifiers: Swine, Liquid manure pit, Land disposal, Orthophosphate, Settled solids.

A swine testing barn with 24 pens, each 6' X 16', was put into operation at the West Tennessee Experiment Station in October, 1970. The barn had slatted floors and a liquid manure pit. The liquid manure from the collection pit was removed by a vacuum spreader tank equipped with 2 plows for placing the waste beneath the surface of crop land. The pit varied from 3.5 feet deep in the center to 4.0 feet deep at each end, giving a total storage capacity of 4,500 cubic feet. Pit walls were constructed of 8-inch concrete blocks with concrete-filled cores. The concrete floor of the pit sloped 1-inch in 10 ft. toward each end where 6-feet deep sumps were located. The concrete slats were 8 feet long and 5 inches wide, and spaced 1 inch apart. Samples from the bottom of the pit contained much more nitrate nitrogen and orthophosphate than samples from the top of the pit. Bottom samples had a chemical oxygen demand of 80,000 parts per million or 8 percent. During periods when swine-cooling sprinklers were not in use, the waste collected at 0.27 cubic feet per pig per day. During 3 years' operations, the settled solids tended to accumulate from 4 to 8 inches depth in winter and then decline to about 2 inches depth in summer. (Rowe-East Central).

## 3175 - B2, C1, E2
### LIQUID POULTRY WASTE,

Professor and Associate Head, Department of Agricultural Engineering, University of Tennessee, Knoxville.
J. I. Sewell
Animal Waste Management Facilities and Systems, Bulletin 548, University of Tennessee, Agricultural Experiment Station, July, 1975, p. 20-21. 1 fig.

Descriptors: Liquid wastes, Poultry, Slurries, Physical properties, Pumping, Viscosity.
Identifiers: Land disposal.

The dry-matter and viscosity characteristics of poultry manure, which are closely related to slurry pumping characteristics, were evaluated at the University of Tennessee Poultry Farm. The 3 caged layer houses studied were equipped with shallow pits under cages and a dragboard system for conveying the liquid manure from beneath the cages to liquid manure pits outside the houses. Following agitation, waste samples were collected from pits next to the houses. The sample viscosity increased markedly with dry-matter concentrations exceeding 10 percent. At dry-matter levels above 10 percent, difficulties in vacuum loading a slurry tank and in pumping with a centrifugal sewer pump were experienced. Accumulations of feathers and other extraneous material compounded the problem. The wide range in dry-matter contents found in the slurry resulted from varying dilutions by wash water, spillage, leaking waterers, rainfall, and relative humidity. While adequately diluting the slurry greatly facilitated pumping, the dilution water had to be hauled and spread on land and total hauling costs were correspondingly increased. (Rowe-East Central)

## 3176 - A5, B2, C1, C2, C3, E2
### SPRINKLER IRRIGATION OF DAIRY MANURE SLURRY,

Professor and Associate Head, Department of Agricultural Engineering, University of Tennessee, Knoxville
J. I. Sewell, J. C. Barker, C. R. Holmes and J. N. Odom
Animal Waste Management Facilities and Systems, Bulletin 548, University of Tennessee, Agricultural Experiment Station, July, 1975, p. 22-32. 6 fig, 2 tab.

Descriptors: Sprinkler irrigation, Slurries, Dairy industry, Liquid wastes, Agricultural runoff, Rainfall, Chemical properties, Physical properties, Biological properties, Groundwater pollution, Phosphorus, Potassium, Bacteria, Coliform, Nutrients.

Identifiers: Land disposal.

An experimental manure slurry irrigation system was established at the University of Tennessee Main Station Dairy Farm milking 125 cows to study the collection of lot runoff and its disposal on land. The runoff from approximately 1 acre of lot and roof area was collected into drains and flowed by gravity into the slurry storage tank. A chute was used to direct the manure from the cow and storage barn into the slurry tank. An irrigation pump at the end of the tank carried through portable irrigation pipe and applied it to land through a large sprinkler. Study results indicated that: (1) the dry matter in the slurry form presented no problems of solids accumulation on the ground surface, (2) contamination of shallow groundwater was suspected, (3) rainfall runoff from the surface of the area receiving slurry irrigations exhibited high bacterial and chloride concentrations, (4) waste application by slurry irrigation should not exceed crop fertilization rates, (5) soil phosphorus increased markedly during 4 years of manure slurry applications, and soil potassium increased to a lesser extent, and (6) manure slurry had little effect on soil acidity. (Rowe-East Central)

## 3177 - A8, B2, E2
### FURROW IRRIGATION OF CORN SILAGE WITH DAIRY MANURE SLURRY,

Former Graduate Assistant, Department of Agricultural Engineering, University of Tennessee, Knoxville
R. S. Pile, J. B. Wills, and J. I. Sewell
Animal Waste Management Facilities and Systems, Bulletin 548, University of Tennessee, Agricultural Experiment Station, July, 1975, p. 33-36. 1 fig, 3 tab.

Descriptors: Irrigation, Slurries, Crop response, Furrow irrigation, Rainfall.
Identifiers: Dairy manure, Corn silage.

This study was conducted during the 1971 through 1974 growing seasons at the Cherokee Dairy Farm in Knoxville to determine the effects of furrow irrigation with dairy manure slurry on the corn silage yield of an East Tennessee stream terrace. Irrigation needs were determined by observing the crop, apparent soil moisture conditions, and precipitation data. Corn silage yields were determined by hand-harvesting and weighing green corn from two 50-foot, two-row subplots in the irrigated plot and two similar subplots from a nearby non-irrigated area. It was found that dairy manure slurry irrigation of corn increased corn silage yields during all of the four growing seasons considered. This increase was attributed to the combined effect of plant nutrients and water. Growing-season rainfall was above normal during all seasons considered. Cultivator furrows carried the irrigation water and manure slurry satisfactorily. It was felt that the layer of fibrous material and manure solids which formed at the soil-slurry interface may have restricted slurry intake. (Rowe-East Central)

## 3178 - A8, B2, C2, E2
### LIQUID SWINE WASTE ON SOILS AND CROP YIELDS,

J. R. Overton, J. I. Sewell, and G. M. Lessman
Animal Waste Management Facilities and Systems, Bulletin 548, University of Tennessee, Agricultural Experiment Station, July, 1975, p. 37-43. 4 tab.

Descriptors: Liquid wastes, Crop response, Soils, Slurries, Soybeans, Potassium, Nitrogen, Phosphorus.

Identifiers: Swine, Land disposal, Corn, Nodulation.

Liquid swine waste was applied on the surface of and injected into a Collins fine sandy loam and a Dexter loam soil on the West Tennessee Experiment Station. The Collins is a moderately well-drained, permeable, friable soil from young alluvium. The Dexter is a well-drained terrace soil with a friable silt loam or loam topsoil and a firm silty clay loam subsoil. A similar experiment was conducted on Hatchie and Almo soils employing different rates of waste than used on Collins or Dexter. Hatchie and Almo soils are more poorly drained and less permeable than the Dexter soils. Test plots were planted to corn and soybeans. Yield and soil-test data were obtained. Results were: (1) Some grain yield depression occurred in 1971 under poor growing conditions, (2) Yields remained low in 1972 because of late planting dates, (3) Effects of waste applications were not marked on soybeans except for nodulation effects observed in 1973. (4) Soil test results indicated some increases in P and K after repeated applications and some penetration of K on Collins and Dexter to 12-18 inches, and to 18-24 inches, on the Almo soil. (5) The manure applied varied in nitrogen content and possibly in distribution and incorporation. The manure treatments raised soil test values for potassium. (Rowe-East Central)

## 3179 - A3, A4, B1, C2, C3
### EFFECTS OF AGRICULTURAL LAND USES ON RUNOFF QUALITY,

Professor and Associate Head, Department of Agricultural Engineering, University of Tennessee, Knoxville
J. I. Sewell and J. M. Alphin
Animal Waste Management Facilities and Systems, Bulletin 548, University of Tennessee, Agricultural Experiment Station, July, 1975, p. 44-46. 1 tab, 19 ref.

Descriptors: Agricultural runoff, Land use, Water pollution, Tennessee, Bacteria, Biochemical oxygen demand, Dissolved oxygen, Nitrates, Agriculture.
Identifiers: Orthophosphates, Fecal coliforms.

Twenty-four test sites from 5 locations and representing much of Tennessee's agriculture were selected for study. The purpose was to evaluate the effect of several agricultural land uses on surface runoff quality near the areas of study. Grab samples were collected 4 to 10 times from each site. Bacterial cultures were made for both total and fecal coliform counts. Biochemical oxygen demand and dissolved oxygen tests were conducted. Also nitrate-nitrogen and orthophosphate sample concentrations were determined. It was found that concentrations of livestock increased the biochemical oxygen demand, orthophosphates, and bacterial counts of samples collected from nearby streams. Of 13 sites examined on flowing streams, none had dissolved oxygen or nitrate-nitrogen levels which failed to meet EPA standards; and only one failed to meet the bacterial count criteria. (Rowe-East Central)

## 3180 - A4, A6, B1, D1, D2, E2, E3, F1
### METHODS AND TRENDS IN LIVESTOCK WASTE MANAGEMENT IN JAPAN,

Department of Animal Husbandry, Faculty of Agriculture, Niigata University, 2-Igarashi, Niigata, Japan
M. Yamaguchi
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 622.

Descriptors: Livestock, Legislation, Pollution abatement, Economics.
Identifiers: Japan, Waste management.

High density livestock production, started and encouraged by the Japanese government after World War II, has become a big source of pollution. Consequently, environmental pollution laws have been passed to combat this situation. Among these are the water pollution control law, the law of prevention of odors, and the law of treatment and purification of substances discharged from economic production units. In response to these laws, the Japanese are trying to develop better management techniques. Methods that are currently considered applicable under Japanese conditions are the following: (a) land disposal, (b) hydraulic collection and transport, (c) dehydration and incineration, (d) refeeding. Subsidies and agricultural cooperatives have been established to assist the farmers in constructing facilities and purchasing equipment for waste disposal. Subsidies and cooperatives have also encouraged development of animal production units away from urban areas, even to the point of defraying costs of moving existing facilities away from the cities. Educational and research programs have also been implemented. In the meantime, agricultural pollution and perennial feed shortages have tended to depress growth of the livestock industry in Japan. Practical management methods suited to the small-size production units of Japan must be found. (Cocon-East Central)

### 3181 - B2, B3, E2

### ANIMAL WASTE MANAGEMENT IN FINLAND,

Retired Director, Work Efficiency Association, Vantaa, Finland
M. Sipila
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 623.

Descriptors: Liquid wastes, Equipment, Design, Economics, Solid wastes.
Identifiers: Finland, Waste management, Field disposal.

In Finland, studies on manure have been aimed at: (1) examining methods that reduce and facilitate labor, (2) developing cheap construction, and (3) investigating the economic benefit that manure gives by means of crop farming. Labor requirements have been examined at different sized cow farms and piggeries with different manure systems. Experiments have shown that in a stall cow barn with liquid manure, the cleaning, disposal, and littering take only about half the time per cow as compared to the same job where solid manure is disposed by manual methods. Liquid manure can be loaded, transported, spread, and plowed in less than half the time needed for the same job using the solid manure method. Most liquid manure systems in Finland use the damming up method in which manure is gathered in a channel covered with a steel grille and then the channel is emptied by opening a drain into a concrete collecting pit outside the building. Runoff is usually collected and handled with the manure. The collecting pit is usually emptied in the spring and autumn by means of slurry tankers which surface spread the wastes on fields. In stall cow barns, another method may be utilized in which liquid manure continually floats along a flat-bottomed channel into a collecting pit. This is the "floating manure method". Experiments have been made with placement slurry tankers. In comparison with tankers that spread on the surface, considerable yield increases, odorless spreading, prevention of flowing on the surface, and improved hygienic qualities of grassfeed are obvious advantages. The expense of such machines, however, make them more suitable for group ownership. (Edwards-East Central)

### 3182 - A4, A7, A8, B2, C2, D1, D2, E2

### STUDIES ON THE COLLECTION AND DISPOSAL OF SLURRY IN NORTHERN IRELAND,

Reader in Agricultural and Food Chemistry Department, Queen's University, Belfast, and Principal Scientific Officer, Department of Agriculture, Northern Ireland
J. S. V. McAllister
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 624.

Descriptors: Slurries, Poultry, Cattle, Climates, Physical treatment, Chemical treatment, Water pollution, Air pollution, Soil contamination.
Identifiers: Northern Ireland, Land Spreading, Swine, Toxic gases, Refeeding, Recycling.

Soil type, cropping system, and climate are the three factors which decide the amount of slurry that can be safely spread on land. A relatively dry climate with a considerable amount of arable cropping is the most satisfactory condition. Conditions deteriorate in a humid climate with heavy rainfall, lower evaporation, and much of the land under grass, as in Northern Ireland. Due to this fact, much investigation is being undertaken concerning problems with the collection and disposal of slurry. When slurry is stored, toxic gases are produced, the most dangerous being hydrogen sulfide. Slurry which is being carelessly spread or handled can cause pollution of water, of the atmosphere, and of the land. Poultry slurry can be dried for use as a ruminant food, and cattle slurry is produced under conditions where there is adequate land for disposal, but pig slurry presents a major problem. Removal of solids by centrifugation and incineration gives an ash high in calcium and magnesium phosphates. Study is being conducted concerning the use of effluents as a substrate for producing single cell protein. (Edwards-East Central)

### 3183 - A11, A12, B1, C1, C2, E3

### STUDIES ON THE USE OF SOLID SUBSTANCES OF PIT WASTE (SLURRY) IN THE FEEDING OF FATTENING CATTLE,

Animal Feeding Department, Animal Production and Veterinary Medicine Section, Karl-Marx University of Leipzig, Jena, German Democratic Republic
G. Flachowsky, H. J. Lohnert, and A. Henning
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 625.

Descriptors: Slurries, Cattle, Performance, Physical properties, Chemical properties, Sheep.
Identifiers: Refeeding, Swine wastes.

The solid substances of liquid manure from pigs were fed in tests to sheep and cattle. The solid substances of pigs being fattened contained, after the elimination of the liquid matter, 16 percent crude protein, 66 percent cell wall parts, 2 percent ether extracts and 16 percent ash. The digestibility of the organic substances gained in this way varied between 45 and 55 percent. It was found that one kg dry matter equaled 90 g digestible protein and about 400 energetic feeding units for cattle. The solid substances of pig liquid manure were fed to 520 head of cattle. When 30 percent of the solid substance was worked up into ready-made pellets, a weight growth of up to 1000 to 1200 g occurred over a long period of time. A combination of the pellets plus straw, grain and sugar beet proved to be most efficient. At the end of the fattening period, the bulls were slaughtered and various organs and body parts were biochemically, bacteriologically and gustatorially tested. The quality of the meat of those animals had not been affected. (Edwards-East Central)

### 3184 - A6, A7, A10, B2, B3, B4, C2, C3

### AGRICULTURAL CONDITIONS AND LIVESTOCK WASTES IN NORWAY,

Professor, Agricultural Structures Department, Agricultural University of Norway, N-1432 Aas-N.L.H.
O. Hjulstad
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 626.

Descriptors: Waste storage, Liquid wastes, Solid wastes, Gases, Odor, Pathogenic bacteria, Separation techniques, Parasites.
Identifiers: Norway, Bedding, Waste management.

Although the total land area of Norway is 324,000 sq. km., only 2.8 percent of this total land area is agricultural land. Rocks, mountains, and lakes make Norway short of arable land. Potatoes and some vegetables can be raised any place where people are settled and good grass crops grow in all parts of the country. The country is self-supplied with livestock products, but it must import concentrates and small grains and fruits. Most of the income for farmers, however, is from the high standard of livestock production. Most manure is stored in cellars beneath animal pens, but in some sections of the country the liquid part of the manure is separated from the solid part and stored in separate tanks. The shortage of bedding in many parts of the country causes anaerobic fermentation and gas and odor problems, as well as risk of the development of pathogenic bacteria. Experiments with liquid composting manure are presently being conducted to: (1) reduce poisonous gas and odor problems, (2) reduce development of pathogenic agents and parasites, and (3) bring the manure to a consistency which can be easily handled as a liquid. (Edwards-East Central)

### 3185 - A4, A6, B1, F2

### THE SWEDISH EXPERIENCE IN CONNECTION WITH ENVIRONMENT PROTECTION AT ANIMAL PRODUCTION SITES,

Head of Section, National Swedish Protection Board, Fack, 171 20 SOLNA, Sweden
S. Berglund
Managing Livestock Wastes, Proceedings 3rd International Symposium on Livestock Wastes-1975, University of Illinois, Urbana-Champaign, April 21-24, 1975, p. 627.

Descriptors: Regulation, Legal aspects, Water pollution, Odor.
Identifiers: Sweden, Environmental protection.

The Swedish Environment Protection Act of 1969 specifically prohibited some forms of pollution, such as the discharge of animal urine and silage effluent into streams and lakes. In 1973, the 1969 Guidelines for Environment Protection at Animal Production Sites were revised in terms of location of new animal units, requirements of cultivated land area to number of animals, and manure storage and handling requirements. These new requirements are supervised and enforced by provincial administrators. Investigations on different methods of reducing odors from spreading manure, along with emissions from animal stables and water pollution problems are being carried out. Cooperation among authorities, local agricultural advisors, and farmers' unions have been successful. (Edwards-East Central)

### 3186 - B3, C2, D3, E2

### A FARM-SCALE COMPOSTING METHOD IN OREGON,

Delphian Foundation, Sheridan, Oregon
J. W. Nunley
Compost Science, Vol. 17, No. 2, p. 20-22, March-April, 1976. 3 fig, 3 ref.

Descriptors: Oregon, Nitrogen, Anaerobic conditions, Aerobic conditions.
Identifiers: Composting, Land spreading.

Due to prior leasing arrangements, the Delphian Foundation, located near Sheridan, Oregon, was unable to occupy most of their agricultural land until early fall. This left very little time to incorporate compost into more than 200 acres of heavy clay soil. Two methods of applying compost were studied: (1) Sheet composting—organic matter is spread on the land and the land is allowed to lie fallow for a couple of seasons while the organic matter breaks down. Disadvantages of this method are that the land is taken out of production, and nearly half of the nitrogen content of the matter is lost to the air while it is being converted to compost. (2) Anaerobic method — mixtures of organic matter are formed into windrows through use of dump trucks and manure spreaders. The organic matter remains in piles without being turned. Advantages are a tremendous saving of time and labor, and 100 percent of the nitrogen can be retained. The Delphian Foundation utilized the anaerobic method. After the windrows were made, they were wetted down to near field capacity and then covered with black polyethylene plastic. The plastic was held in place by old tires. Using this method, they were able to produce more than 2100 tons of compost during a two and one-half month period in the fall of 1974. Other methods that will be tested for compost production include the application of municipal sewage sludges and biodynamic and mechanical methods. (Edwards-East Central)

### 3187 - A11, B1
## HORMONE INDUCED LACTATION IN THE BOVINE. III. DYNAMICS OF INJECTED AND ENDOGENOUS HORMONES,
Department of Dairy Science, Ohio Agricultural Research and Development Center, Wooster
L. B. Willet, K. L. Smith and F. L. Schanbacher
Journal of Dairy Science, Vol. 59, No. 3, p. 504-514, March, 1975. 7 fig, 4 tab, 47 ref.

Descriptors: Urine.
Identifiers: Hormones, Lactation, Dairy cattle, Estrogen, Progesterone, Feces, Excretion.

A study was conducted to determine rate and route of excretion of radiolabeled $E_2^\beta$ and P mixture used for inducing lactation. Also, immunoreactive total estrogen, progesterone (P), and prolactin of plasma, and urinary total estrogen were measured in samples collected at close intervals during and following hormone injections. Feces accounted for about 90 percent of the P and 60 percent of the $E_2^\beta$ excreted. Approximately 1/3 of the estrogen excreted was via the urine. Milk was found to be a minor pathway for excretion of metabolites of female sex steroids. (Rowe-East Central)

### 3188 - A8, B3, E2
## YIELD AND GROWTH OF CORN AS AFFECTED BY POULTRY MANURE,
Assistant, Department of Plant Science, College of Agricultural Science, University of Delaware
J. G. Shortall and W. C. Liebhardt
Journal of Environmental Quality, Vol. 4, No. 2, p. 186-194, March-April, 1975. 6 tab, 10 ref.

Descriptors: Crop response, Salinity, Corn.
Identifiers: Poultry manure, Land disposal.

At the rates of 0, 22, 56, 90, 168, and 224 metric tons/ha, poultry manure was surface applied and plowed under on an Elkton loamy sand. A treatment of 22 metric tons/ha of manure plus the 224-5-186 kg/ha plus a fertilizer treatment 224-5-186 kg/ha (N-P-K) was also conducted. Each of these treatments was replicated four times in a randomized block design. Excessive salt in soil was found to be the most important cause of yield reduction after high rates of poultry manure had been applied. Reduction in germination of corn was caused by high rates of poultry manure. (Edwards-East Central)

### 3189 - A4, B2, C2, D3, E3
## PHOTOSYNTHETIC PURIFICATION OF THE LIQUID PHASE OF ANIMAL SLURRY,
Department of Agricultural and Food Chemistry, The Queen's University of Belfast, Newforge Lane, Belfast, Northern Ireland and Agricultural and Food Chemistry Research Division, Department of Agriculture, Northern Ireland
M. K. Garrett and M. D. B. Allen
Environmental Pollution, Vol. 10, No. 2, p. 127-139, February, 1976. 6 fig, 2 tab, 15 ref.

Descriptors: Slurries, Algae, Nitrogen removal, Recycling, Effluents, Water pollution.
Identifiers: Phosphorus removal.

A strain of Chlorella vulgaris was selected from 18 species of freshwater algae which were screened for their ability to grow in and remove phosphorus from slurry supernatants. In a laboratory batch culture system, phosphorus was found first to be solubilised by the developing endogenous bacterial community, then accumulated by the algal cells. Phosphorus removal from the slurry was most rapid on a per cell basis during the early stages of algal growth; however, significant removal occurred even after the maximum algal cell concentration was achieved. The kinetics for nitrogen removal differed from those for phosphorus. The major loss of nitrogen seemed to be due to volatility and the algal contribution was seen only in the later stages of growth. Cells harvested at the end of the logarithmic phase contained 42 percent true protein. Thus, the product might be useful in a cereal-based diet. The study data provide preliminary evidence that algal culture is a biologically feasible method of treatment for the liquid phase of slurry, potentially capable of producing an effluent approaching Royal Commission Standards. (Rowe-East Central)

### 3190 - A8, B1
## THE OXYGEN-ETHYLENE CYCLE AND THE VALUE OF COMPOST,
Plant Pathologist, Washington State University, Pullman.
R. J. Cook
Compost Science, Vol. 17. No. 2, p. 23-25, March-April, 1976.

Descriptors: Organic wastes, Oxygen, Cycle, Soils, Crop response.
Identifiers: Ethylene, Plant diseases.

Today it is widely recognized that most soilborne diseases of crops and ornamental plants can be controlled to one degree or another with the incorporation into the soil of a decomposable organic amendment. Dr. Alan Smith and R. James Cook, working at the Chemical and Biological Research Institute of the New South Wales Department of Agriculture in Sidney, have discovered a basic soil microbiological process which is believed to have far reaching implications for soil and plant health. The process involves the production of a biologically very active gas, ethylene, which seems to serve as a basic regulator in soil biology. Evidence indicates that ethylene is produced in virtually all soils of the temperate and tropical regions, and that it may be inhibitory to some organisms and stimulatory to others. Of all soil treatments tested to date, organic amendments are the best promoters of ethylene production. Organic amendments stimulate greatly accelerated aerobic activity and hence increased volume of ethylene-producing anaerobic microsites, and the organic substrates provide the energy-rich food necessary for ethylene production. The discovery of ethylene production by anaerobes has opened many new and exciting doors for future research on the soil-microorganism-plant ecosystem, both for the naturalist interested in biology of wild habitats and for the agriculturalist interested in farm and garden. (Rowe-East Central)

### 3191 - A11, B1
## BOVINE LEPTOSPIROSIS,
National Animal Disease Center, North Central Region, Agricultural Research Service. U. S. Department of Agriculture, Ames, Iowa.
O. H. V. Stalheim
NebGuide G75-270, Cooperative Extension Service, Institute of Agriculture and Natural Resources, University of Nebraska, December, 1975, p. A-11.

Descriptors: Cattle, Diseases, Urine.
Identifiers: Leptospirosis.

A leptospire is a slender, spiral bacteria with a characteristic hook in one or both ends. The leptospire causes an infectious disease in man and animals called leptospirosis. Leptospirosis can be transmitted directly by droplets of infected urine, by breeding and artificial insemination, or indirectly by contaminated water. Bloody urine, jaundice, and "storms" of abortions are symptoms of this disease in beef cattle. Of the 125 types of leptospires, only 3 are known to cause disease in cattle — Leptospirapomona, hardjo, and grippotyphosa. In calves and young fattening cattle, the disease causes fever, prostration, jaundice, bloody urine, anemia, and finally death. In older cattle, the symptoms are varied. In milking cows, the milk turns thick, yellow and blood tinged. Anemia and icterus (jaundice) are symptoms in the acute form of the disease. The most significant lesions are found in the kidneys in the form of a reddish-brown mottling of the cortex. The urine is a clear-red or port-wine color. Hemorrhages in the heart and lymph nodes are also seen in severe cases. Mortality for cattle infected with the diseases ranges from 5 to 15 percent. No form of treatment will have an effect once destruction of the red blood cells has developed. (Edwards-East Central)

### 3192 - A6, B2, D2, D3
## EFFICACY OF CERTAIN CHEMICAL AND BIOLOGICAL COMPOUNDS FOR CONTROL OF ODOR FROM ANAEROBIC LIQUID SWINE MANURE,
Pennsylvania State University, University Park 16802.
C. A. Cole, H. D. Bartlett, D. H. Buckney, and D. E. Younkin.
Journal of Animal Science, Vol. 42, No. 1, p. 1-7, January, 1976. 5 fig, 4 tab.

Descriptors: Liquid wastes, Biological treatment, Chemical treatment, Anaerobic conditions, Denitrification, Sulfides.
Identifiers: Odor control, Swine, Manure pits.

The use of biological and chemical treatments to control malodors in swine pits was investigated. Some treatments were studied as batch odors, while others were applied over a period of months. The discovery of effective and economical application rates was the primary goal of this investigation. It was found that: (1) The reduction of sulfide concentrations and associated odor could be obtained by treating the contents of swine pits with $H_2O_2$, $KMnO^4$, NaOCL, or $C10_2$, (2) While $NaNO_3$ changed the odor in simulated swine manure pits when active denitrification was occurring, total odor strength was not reduced. (3) Disinfecting and emulsifying compounds containing orthodichlorobenzene, dried bacterial preparations, and dried enzymes were all ineffective in improving sulfide or ammonia levels. (Edwards-East Central)

### 3193 - B1, E3, F4
## HUMAN BEHAVIORAL FACTORS IN WASTE MANAGEMENT,
Soil Scientist, Agricultural Research Service, U.S. Department of Agriculture, Fort Collins, Colorado 80521
F. A. Norstadt
Proceedings of the 30th Annual Meeting of the Soil Conservation Society of America, San Antonio, Texas, August 10-13, 1975, p. 153-157. 1 tab, 17 ref.

Descriptors: Recycling.
Identifiers: Waste management, Attitudes, Economics.

Solutions to waste management problems inherently lie in the realm of the psychology of the common man. He is the polluter and he is the one to make the decisions and takes the actions to solve our waste management problems. Part of the problem with wastes can be ascribed to people's attitudes and motives toward the wastes and waste management. The solution to waste problems requires new technological methods and changes in the innate or natural behavior of man. The ultimate responsibility for improved maintenance and control of the environment rests with the individual citizen. The object of total waste management should be to manage each area of economic activity to provide the greatest yield consonant with improving the quality of life for mankind. In addition, we must modify waste generation and management, providing incentives to eliminate, reduce, recycle, and reuse waste products. We cannot expect to effectively change people's attitudes and behavior by telling them something or by coercion. They must become involved by interests and concerns. The overwhelming motivation for recycling is the cash incentive. (Rowe-East Central)

### 3194 - B1, D3, E3
## METHANE GAS FROM MANURE NOT READY YET,
Anonymous
Nebraska Farmer, Vol. 118, No. 16, p. 52-53, August 21,

1976.

Descriptors: Fuels, Methane, Organic wastes.
Identifiers: Recycling.

Methane gas is being studied as a fuel for home use. This gas is produced when bacteria called acid formers break down the organic material into a series of fatty acids. Then bacteria called methane formers reduce the organic acids to methane gas and carbon dioxide. Richard White, Extension agricultural engineer at Ohio State University, said this methane gas would make a cleaner environment and fuel for home use, but large-scale production isn't practical because of the costly equipment necessary to generate usable quantities of methane. The greatest benefit would be the energy value of the gas. A well insulated home could be heated every day by 535 hogs, or ninety-nine 1,200 pound dairy cows. Since the gas is highly explosive, storage and transportation are two major problems. Heating demands are seasonable and storage would be required for long periods of time and this presents another problem. White feels more study is needed before methane gas can be marketed for commercial use. (Edwards-East Central)

## 3195 - A9, A10, A11, A12, B1

### HOUSE FLY CONTROL GUIDE,

Extension and Research Entomologist, University of Nebraska, Lincoln.
J. B. Campbell
Nebguide G75-212, Cooperative Extension Service, Institute of Agriculture and Natural Resources, University of Nebraska, March, 1975, D-5, 3 tab.

Descriptors: Insecticides, Diseases, Management.
Identifiers: Fly control.

The house fly can breed in a variety of areas, such as manures, garbage, sewage, food wastes, lawn clippings, septic tanks and silage. Since the house fly can carry more than 20 human and animal diseases, such as mastitus, pinkeye, typhoid fever, chloria, and tuberculosis, it is a pest to both man and animal. Finding and eliminating breeding places if the first step in fly control. Screening windows and doors, along with placing sticky traps at entrance points, will reduce the number of flies getting into buildings. Residual sprays can be sprayed on surfaces where flies rest. Flies resting on the sprayed surface will pick up enough insecticide to kill them. Care should be taken so that residual sprays do not contaminate feed or water. Space sprays are sprays that must hit the fly to kill it. These sprays are used with mist blowers, hydraulic sprayers, foggers, or aircraft around livestock rearing facilities. Insecticide baits should be used around window sills or other areas where flies rest, but out of reach of children or pets. (Edwards-East Central)

## 3196 - A11, B3, E3

### WORKERS STUDY DPW USE IN LACTATING COWS' RATIONS,

Feedstuffs Southeastern Correspondent.
R. H. Brown
Feedstuffs, Vol. 48, No. 21, p. 130, May 24, 1976.

Descriptors: Performance.
Identifiers: Dairy cattle, Refeeding, Dried poultry wastes.

At the Latin American Conference on Livestock and Poultry, Dr. H. H. Van Horn and L. A. Silva said that dried poultry waste in levels up to 10 percent can be fed to lactating cows with little or no reduction in feed intake or milk production and can serve as a source of calcium and phosphorus. The nutritional value of dried poultry waste (DPW) depends on (1) source of waste, (2) type of litter used, (3) initial feed, (4) amount wasted in manure, (5) ventilation, and (6) temperature. DPW obtained from a layer operation of about 50,000 hens was used to test for effects of different levels of dried waste in complete rations, milk production, and composition and digestibility. With different formulations utilizing 0, 10, 20, and 30 percent DPW substituted for citrus pulp, it was found that the 24 lactating cows tested disliked the 30 percent DPW, ate the 20 percent more readily, but ate the 10 percent DPW ration as well as the control ration. It was also found that the milk yield on 10 percent DPW was equal to that of the control diet. Higher levels of DPW depressed feed intake, milk yield, milk protein percent, and total yields of milk nutrients as well as body weight. The loss of citrus pulp in the ration resulted in a decrease of the fat percentage in the milk. (Edwards-East Central)

## 3197 - A11, B2, B3, B4, E2

### HOW SLATTED FLOORS AND ALLEY SCRAPERS COMPARE,

Anonymous
Hoard's Dairyman, Vol. 12, No. 5, p. 302, 312-313, March 10, 1976. 3 fig, 2 tab.

Descriptors: Costs, Wisconsin, Aluminum oxide, waste storage.
Identifiers: Waste handling, Free stall barns, Slatted floors, Solid floors, Slipping, Scraping, Land disposal.

Wisconsin research was conducted in order to examine 3 types of free stall barns on a side-by-side basis and compare the investments, operating costs, strong points and weaknesses of each system. Wisconsin's experimental unit was divided into three 42' X 50' "barns" which each housed 20 cows. One section of the barn had slatted floors with a liquid manure tank underneath (Barn A). The second section (Barn B) was also a warm barn but had solid floors which were cleaned with a mechanical scraper operated by a time clock. The scraper also cleaned the alleys in the third barn which was a cold unit (Barn C) with no insulation or mechanical ventilation. Slippery floors were prevented in Barns B and C by applying aluminum oxide to the concrete floors just before troweling. The cost of the recommended rate (25 lb 100 sq. ft.) was 17 ½ cents per square foot. The disadvantage of aluminum oxide application was that it wore out the manure scraper more readily. There was little difference in the annual cost per cow between Barns B and C. The heating of the floor in Barn C (for eliminating buildup of frozen manure) was expensive and offset the cost of insulation and mechanical ventilation of Barn B. If an alternative method, such as tractor scraping, had been used in Barn C, a yearly savings of more than $30 per cow would have been realized. Barn A had a $15 per cow higher annual cost than Barn B and a $7 higher cost than Barn C due to the expense of the concrete liquid manure tank. However, an advantage of the slatted floor system was that there was no mechanical scraping equipment to cause the inconvenience of breakdowns. (Penrod-East Central)

## 3198 - A2, A4, A5, B1, C1, C2, E2, F1

### CONFINED ANIMALS AND PUBLIC ENVIRONMENT,

Region Extension Specialist, Oklahoma State University, Stillwater 74074
M. D. Paine
Publication GPE-7000, University of Nebraska, Cooperative Extension Service, 1972, 4 p. 5 fig.

Descriptors: Confinement pens, Agricultural runoff, Water pollution, Ground-water pollution, Great Plains, Cattle, Costs, Nutrients, Nitrates, Biochemical oxygen demand.
Identifiers: Land disposal, Total solids.

The major indicators for the magnitude of pollution in water are: total solids, biochemical oxygen demand, nitrates, and nutrients. Under normal circumstances, manure from cattle falls on land where the cattle eat. The amount of total solids or biochemical oxygen demand that reaches water depends upon rainfall which causes runoff. Research studies indicate that about 2 percent of the total possible biochemical oxygen demand loading reaches a water stream. Under severe conditions caused by heavy storms or snowmelt, up to 5 percent of the biochemical oxygen demand may reach a stream. In the past, feedlots that developed in the Great Plains caused severe pollution problems because climatic conditions were ignored and feedlots were built in convective thunderstorm areas. However, great headway has been made in those states through the use of runoff control measures. Another problem that must be guarded against is nitrate pollution of groundwaters under feedlots. In cases where the feedlot surface is lightly stocked, is maintained for only a portion of the year, or is abandoned without cleaning, natural processes break up the compacted lower layer and allow nitrates to move downward toward groundwater. There is little evidence of nitrate buildup under active feedlots. It is estimated that 80-100 million tons of manure must be hauled to adjacent cropland every year. However, the cost of processing solid waste from municipalities and industries is at least 40 times greater than hauling animal manure produced in confinement. Estimates of the total solid materials produced by animals must consider factors for confinement, moisture, and the type of ration. (Rowe-East Central)

## 3199 - A5, A8, B1

### INFILTRATION ON A CATTLE FEEDLOT,

U. S. Department of Agriculture, Lincoln, Nebraska.
L. N. Mielke and A. P. Mazurak
Presented at the 1975 Annual Meeting, American Society of Agricultural Engineers, University of California, June 22-25, 1975, Paper No. 75-4028, 14 p. 2 fig, 4 tab, 16 ref.

Descriptors: Feedlots, Cattle, Infiltration rates, Nitrates, Soil profiles, Groundwater pollution, Permeability.
Identifiers: Soil interface layer.

The most common single criterion that is used to indicate water pollution is the nitrate-nitrogen $NO_3$-N content. A common assumption that is made is that since $NO_3$-N is very soluble and mobile in water, where water goes, $NO_3$-N goes also. A study was conducted at a Platt River Valley feedlot to determine some of the characteristics of infiltration of water into and water and gas movement through a feedlot profile. Since physical soil characteristics indirectly affect nitrogen conversion, they also directly influence the nitrogen status under the feedlot. Water infiltration in the feedlot was determined by the double-cylinder method. Two methods, the fixed hook and the float-controlled calibrated supply tank, were used. The equipment was protected from cattle destruction by a fence. Using a Giddings hydraulic soil probe, undisturbed feedlot soil cores encased in heat-shrink plastic were taken. The interface layer in the feedlot developed as a result of the hoof action and manure cover, and was the most restrictive layer to water movement. Study data showed that air and water permeabilities were lowest in the interface section and increased in the soil below. The average rate of water entry was 1.7 g/cm$^3$ at 18 percent water content. The authors concluded that undisturbed feedlot soil cores and feedlot interface material compacted at water content for maximum density are effective barriers to water movement. (Penrod-East Central)

## 3200 - A9, A10, A11, B1

### STABLE FLY CONTROL GUIDE,

Extension and Research Entomologist, University of Nebraska, Lincoln
J. B. Campbell
NebGuide G75-211, Cooperative Extension Service, Institute of Agriculture and Natural Resources, University of Nebraska, March, 1975, D-4. 3 tab.

Descriptors: Insecticides, Cattle, Performance.
Identifiers: Stable flies, Fly control, Breeding areas.

The life cycle of the stable fly from egg to adult averages about 24 days, with the total life span of the female being about 20-30 days. Each female lays between 200-400 eggs in this short span. The most common breeding sites are in feedlots or dairy lots where the female deposits her eggs in spoiled or fermenting organic matter mixed with animal manure and dirt. Stable flies feed by piercing the skin and sucking blood. The bite of the fly is painful and large numbers of flies can often make cows go off feed. Sanitation is the first step in controlling the fly population. Steps to follow are: (1) Manure should be removed or mounded. (2) Sick pens, feed storage areas, water systems, fences and gates, feed bunks, and feed aprons should be cleaned regularly. (3) Chemical sprays should be used. There are 3 methods of insecticide fly control: (1) Residual spray is used to spray areas where flies rest. When flies rest on the sprayed areas, they pick up enough insecticide to kill them. These sprays are used on fences, feedbunks, and buildings and usually last between 20-21 days. (2) Area sprays are used to spray directly on flies and should be used 2 or 3 times a week. (3) Animal sprays are used directly on the cattle and this method needs to be repeated at 4-7 day intervals. Applying insecticides to breeding areas is not recommended due to the danger of animal or crop contamination. (Edwards-East Central)

### 3201 - A9, A10, B1

### THE HORN FLY: METHOPRENE IN DRINKING WATER OF CATTLE FOR CONTROL.

U. S. Livestock Insects Laboratory, Kerrville, Texas 78028
M. L. Beadles, J. A. Miller, W. F. Chamberlain, J. L. Eschle, and R. L. Harris
Journal of Economic Entomology, Vol. 68, No. 6, p. 781-785, December 15, 1975. 2 fig, 1 tab, 5 ref.

Descriptors: Insecticides.
Identifiers: Fly control, Methoprene.

The U. S. Livestock Insects Laboratory at Kerrville, Texas, is involved in a pilot program in Hawaii to determine the feasibility of an integrated approach to eradication of the horn fly, Haematobia irritans (L.). A promising orally-administered material that has been investigated at the Kerrville laboratory is methoprene, an insect growth regulator (IRG.) Data from Kerrville tests has indicated that cattle will readily accept drinking water containing methoprene. A field trial was therefore conducted on the Kalaupapa peninsula to examine a method of administering methoprene in drinking water and to determine the effect of methoprene on the population of adult flies. Devices were constructed to meter 0.34 mg of methoprene/liter of water automatically into the troughs of drinking water and a 350-animal herd of cattle. The effect on the population of Haematobia irritans (L.) was determined by bioassay of fresh manure collected at intervals from the pasture. Complete inhibition of development of adult horn flies was achieved. As a result, the number of horn fly eggs on manure droppings in the pasture declined from an average 75 to 13 eggs/dropping, and the number of flies was reduced from an average 360 to 7/animal. However, reinfestation occurred due to migration of horn flies into the area. Also, the control herd in the fattening pen provided a source of reinfestation. (Rowe-East Central)

### 3202 - A6, B2, B4, F3, F6

### AN ICONIC MODEL OF AN UNDER-SLAT FLUSHING SYSTEM,

Agricultural Engineering Department, Michigan State University, East Lansing, 48824
R. J. Ballard, J. B. Gerrish, and T. L. Loudon
Presented at the 1975 Annual Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, Paper No. 75-4556, 15 p. 4 fig, 1 tab, 12 ref.

Descriptors: Model studies, Design, Slope, Volume, Waste storage.
Identifiers: Flushing, Swine manure, Manure transport, Odor control.

An under-slat flushing system for the transport of manure out of a swine confinement building has the following advantages: odor control within the building, reduction of manual labor, and a direct tie-in to an aerobic lagoon. Because there is insufficient knowledge for a good engineering design of such a flushing system, a manure transport system is being studied in the form of an iconic model and its prototype. The system consists of a self-tipping elevated water tank which discharges 3-4 times daily into a sloped flume. Manure which has accumulated in the flume beneath the slatted floor is transported to an anaerobic lagoon. An attempt is being made to develop information that will suggest optimal combinations of tipping tank volume, slope, dumping frequency, and the height of the dump tank above the pit floor. The experimenters also hope to learn how to avoid solids deposits along side walls as sometimes happens in real life. Evaluation of the system is in progress. (Rowe-East Central)

### 3203 - A5, A8, C2, E2

### CHICKEN MANURE, AN EXCELLENT FERTILIZER FOR CORN,

Department of Soil Science, University of Florida, Gainesville
D. Graetz
Proceedings of the 34th Annual Florida Poultry Institute, Gainesville, Florida, May 19-21, 1975, p. 42-46. 3 tab, 2 ref.

Descriptors: Fertilizers, Crop response, Nitrogen, Nitrates, Groundwater pollution.
Identifiers: Poultry manure, Land application.

In 1974, a randomized complete-block experiment was conducted to evaluate chicken manure as a fertilizer for corn. Treatments of 0, 2, 4, 8, 16, and 32 tons/acre of chicken manure (cage manure at 35-40 percent moisture) and 1,000 lbs. of 4-8-16 + 80 lbs. side-dressed N/acre were replicated 5 times. These amounts were applied to 24 x 30 ft. plots on Eustis fine sand. The nitrogen content of this manure was about 2.3 percent. Observations of the treatments early in the growing season indicated that germination was good in all but the 32 ton treatment. From the first data, it appeared that about 8 tons of manure would provide optimum corn yield from the standpoint of both nutrition and prevention of groundwater contamination by nitrates. To meet plant nutrient requirements at application rates less than 6 tons, commercial fertilizer may have to be added. (Rowe-East Central)

### 3204 - A11, B3, C1, C2, D3, E3

### FEEDING ENSILED POULTRY WASTES TO RUMINANTS,

D. L. Cross
Proceedings of the 34th Annual Florida Poultry Institute, Gainesville, Florida, May 19-21, 1975, p. 47-55. 5 tab, 42 ref.

Descriptors: Legal aspects, Chemical properties, Physical properties.
Identifiers: Refeeding, Ensiling, Poultry wastes, Dienestrol acetate.

With recent implementation of Environmental Protection Agency regulations, many producers have been keenly aware of the polluting effects of poultry waste and the costs involved in properly dispersing of the wastes. An alternative to land disposal is to recycle poultry wastes into the diets of ruminant animals. Ensiling may prove to be a good means of preparing wastes for this purpose..Broiler litter is an excellent source of nitrogen for protein and minerals and is similar to corn silage in fiber content. Presently, the feeding of animal wastes is not sanctioned by the Food and Drug Administration. F.D.A. officials are concerned about potential problems from disease organisms, mycotoxins, heavy metals, pesticides, parasites, and drug residues. There have been no reports of harmful effects on animal health from refeeding poultry wastes except where broilers were receiving high levels of $CuSO_4$ or dienestrol acetate. Although the refeeding of wastes is not sanctioned by the F.D.A., some states have published guidelines for the refeeding of wastes. Federal agencies are not concerned with the refeeding of wastes unless there is interstate shipment of wastes or of the final meat product. Recommended procedures for ensiling poultry wastes are given. (Rowe-East Central)

### 3205 - A11, B3, E3

### HATCHABILITY UNAFFECTED BY FEEDING POULTRY LITTER,

Department of Poultry Science, Clemson University, Clemson, South Carolina 29631
J. B. Cooper and B. L. Hughes
Poultry Science, Vol. 55, No. 3, p. 1139-1140, May, 1976. 2 tab, 8 ref.

Descriptors: Poultry, Litters, Performance.
Identifiers: Refeeding, Hatchability.

An experiment was conducted to determine whether or not feeding litter to hens in wire cages would improve hatchability. Three levels of litter, 0, 2, and 5 percent, were mixed with a chicken breeder diet. Each of the 3 diets was fed to 3 groups of 9 hens each for 20 weeks, making a total of 27 hens on each diet and 81 hens in the experiment. S. C. White Leghorn hens kept in individual wire cages for about 13 months of lay were used. The hens were artificially inseminated each week with 0.05 ml. of pooled semen from a broiler strain of males. The males were fed the basal diet containing no litter. Eggs were marked so that fertility and hatchability could be calculated on a per bird basis. Eggs were set weekly for 20 weeks. All eggs candled as being infertile or early dead were examined macroscopically to determine fertility. A statistical analysis was made using the analysis of variance test. No significant differences were found among treatments for fertility or hatchability. Fertility varied from 89.8 percent for the zero poultry litter diet pens to 88.1 percent for both the 2 and 5 percent litter diet pens. Hatchability of fertile eggs was 80.4, 80.0 and 80.2 percent respectively, for hens fed diets containing 0, 2, and 5 percent litter. (Rowe-East Central)

### 3206 - A6, A7, B1, C2

### HYDROGEN SULFIDE PRODUCTION IN SWINE CONFINEMENT UNITS,

Air Pollution Division, Michigan Department of Natural Resources, Lansing.
G. L. Avery, G. E. Merva, and J. G. Gerrish
Transactions of the ASAE, Vol. 18, No. 1, p. 149-151, January-February, 1975. 2 tab, 7 ref.

Descriptors: Confinement pens, Gases, Toxicity, Hydrogen sulfide, Sampling, Temperature, Ventilation.
Identifiers: Odor control, Cadmium hydroxide-methylene blue method.

Three specific problems stemming from confinement-feeding of swine were identified by J. A. Merkel. The first dealt with odor control for the comfort of the producer and his neighbors. The second and third dealt with the possible toxic effects of the individual gases and gas combinations generated in animal wastes and in confinement buildings. A study was conducted to determine the effect of certain parameters on the rate of production of hydrogen sulfide from some typical confinement buildings. Parameters studied included outside temperature, the ratio of the pit area to building volume, the air retention time (ventilation rate) and daily sulfur intake of the animals. Six units, including farrowing and finishing houses, were studied. The units differed in the type of roofing and siding used; use of partial pits or pits under the entire floor; and use of fans. Also, one unit used Wham, a commercial product for odor control. An air sampling machine was built to take 8 air samples in a 24-hour period. Hydrogen sulfide concentrations in the samples was determined by the methylene blue method. The trapping efficiency of hydrogen sulfide was tested by connecting 3 midget impingers in series, so that the air sample was drawn through all 3 impingers. Fan exhaust flow was determined by averaging air velocity over the area of the fan. Study data showed the production of hydrogen sulfide was highly correlated with the following parameters for swine finishing buildings of similar construction: (a) average outside temperature, (b) ratio of pit area to building volume, (c) air retention time for the building and (d) daily sulfur intake. No significant difference of hydrogen sulfide content was noted between samples taken at different times of the day. However, study data did show a significant difference of the hydrogen sulfide content between samples taken on different days. The authors concluded that the cadmium hydroxide-methylene blue method was a very effective procedure for trapping and testing for hydrogen sulfide in swine confinement units. (Penrod-East Central)

### 3207 - A8, B3, E2
### CAN ORGANIC MANURES IMPROVE CROP PRODUCTION IN SOUTHERN INDIA?

Assistant Professor, Department of Agricultural Economics, University of Georgia, Athens.
G. C. W. Ames
Compost Science, Vol. 17, No. 2, p. 7-11, March-April, 1976. 4 fig, 5 tab, 13 ref.

Descriptors: Organic wastes, Crop response, Soils, Fertilizers.
Identifiers: India, Land application.

A study was conducted to measure the effect of organic manures on crop yields under actual farm situations in southern Karnataka State, India. A survey was taken of 136 farms. Paddy and sugar cane received the largest applications of organic manures. There was some evidence that excessively large applications of organic manure reduced paddy yields in a few cases. However, the correlation of organic manures with levels of other inputs, such as fertilizer, pesticides and irrigation, were not known. A more detailed study of farm level yield response to organic manure is required before definite conclusions can be drawn. Such a study should account for such factors as initial soil fertility; rainfall and irrigation; variety and quantity of seed; formulas, quantity, timing and method of fertilizer application; quantity and nutrient content of organic manures; and careful measurement of yields. This data would help Indian farmers allocate scarce resources in a more efficient manner. (Rowe-East Central)

### 3208 - A1, B1, C1, C2, C3, D1, D2, D3, E1. E2. E3. E4, F1, F2, F3, F4, F5, F6
### STUDY OF CURRENT AND PROPOSED PRACTICES IN ANIMAL WASTE MANAGEMENT,

Texas Tech University
G. A. Whetstone, H. W. Parker and D. M. Wells
Study of Current and Proposed Practices in Animal Waste Management, Environmental Protection Agency Report No. EPA 430/9-74-003, January, 1974, 480 p. 1 fig, 6 tab.

Descriptors: Farm wastes, Bibliography.
Identifiers: Thermochemical Processing, Coprophagy.

Current and proposed practices in animal waste utilization and/or disposal were reviewed by means of a detailed search of the literature, by correspondence and by visits with active investigators in the field. Abstracts were prepared of 1162 publications dealing with animal waste utilization and/or disposal, or closely related materials having a direct carry-over potential. These latter publications pertained to some other aspect of manure management or to thermochemical processing of some other organic material. In addition, abstracts of 111 pertinent projects sponsored by the USDA were included in a separate appendix. Land spreading, with or without advantage being taken of the fertilizer and soil-conditioning values, is the ultimate destiny of nearly all manure produced at present. Attention was focused in the report, however, on the less-used but potentially more rewarding processes of gas or oil recovery, refeeding to animals after more or less processing, and using as a culture medium for fly larvae, worms, algae, fungi, yeast, etc., with ultimate disposal of the catabolized manure as a soil conditioner, and utilization of the organisms as feedstuffs. This report was submitted in fulfillment of Contract No. 68-01-0785 under the sponsorship of the Office of Air and Water Programs, Environmental Protection Agency. (Whetstone, Parker, and Wells-Texas Tech University)

### 3209 - A6, B2, C2, D3, F6
### A DESIGN AND MANAGEMENT MODEL OF THE OXIDATION DITCH FOR LIVESTOCK WASTE TREATMENT,

E. J. Kroeker
MS Thesis, Cornell University, August, 1974, 131 p. 19 fig, 16 tab, 49 ref.

Descriptors: Design, Waste treatment, Model studies, Nitrogen, Aeration, Poultry.
Identifiers: Oxidation ditch, Odor control, Solids removal.

Societal trends have turned attention to agricultural problems associated with the disposal of wastes from animal confinement. This thesis deals primarily with one alternative that may be applied to animal waste treatment. A mathematical model was presented to be used as a tool for the design and management of an in-house continuous flow oxidation ditch. The model may be directly applied to describe the treatment of caged-layer poultry wastes for control of odors, conservation of nitrogen or removal of nitrogen. Collected operational data from two oxidation ditches verified the model. The model made reasonable predictions for three aeration design requirements. However, at high concentrations of total solids (greater than 35,000 mg/1), it appears that additional design criteria should be used. The empirical equation used to describe solid removal in the model, however, did not make reasonable predictions. (Penrod-East Central)

### 3210 - A3, A4, B2, C2, D3
### TREATMENT AND DISPOSAL OF CATTLE FEEDLOT RUNOFF USING A SPRAY-RUNOFF SYSTEM,

D. E. Eisenhauer
MS Thesis, Department of Agricultural Engineering, Kansas State University, 1973, 91 p. 7 fig, 66 ref.

Descriptors: Feedlots, Agricultural runoff, Cattle, Irrigation, Waste treatment, Chemical properties, Water pollution.
Identifiers: Spray-runoff, Overland flow.

Land disposal by irrigation has been the most prevalent method for handling feedlot runoff. This thesis evaluates the spray-runoff technique, a special adaptation of the sprinkler irrigation system, as a possible disposal practice. The general principle is to apply wastewater at the top of a uniform grassed slope by sprinkler nozzles at a rate such that a high percent returns as overland flow. Since the biological organisms utilize certain impurities in the water as a food and energy source, the water is treated as it flows over the grass slopes. The treated water is then carried off the field by terrace channels and either released or recycled, depending upon the degree of treatment desired. An experimental spray-runoff system was installed at a 22,000 head feedlot in Kansas. The 10.9 acre treatment field contained 4 sprinkler laterals on which 100 foot spray diameter sprinkler heads were installed. Two parallel terraces, spaced on about 200 foot centers, were constructed to carry the water between laterals off the field. The land slopes varied from 1-3 percent. The loam soil was seeded to a grass mixture of reed canarygrass and tall fescue. Flow measuring and sampling equipment were installed so that both quantity of the applied wastewater and the runoff water could be evaluated. Instantaneous loading rates of 0.04 and 0.08 inches/hour were used. The system was operated during the summer and early fall of 1972. Concentration reductions ranged from 27-60 percent for $BOD_5$, 29-44 percent for Kjeldahl nitrogen, and 35-49 percent for ammonia nitrogen. During the total season, only 25-27 percent of the applied waste water ran off. Due to the low runoff percentage, mass removal percentages ranged from 77 to 97, 74 to 90 for $BOD_5$, Kjeldahl nitrogen, and ammonia nitrogen, respectively. The rainfall runoff from the treatment field also contained considerable amounts of pollution causing material and was of questionable quality for release to surface waters. Further study will be required to determine if crop growth can be maintained. (Ott-East Central)

### 3211 - A6, A11, B3, C2, E3
### RECYCLING POULTRY NUTRIENTS,

Department of Poultry Science, Michigan State University, East Lansing
H. C. Zindel
Animal Nutrition and Health, Vol. 26, No. 9, p. 6-7, September, 1971. 1 tab.

Descriptors: Dehydration, Odor, Performance, Fertilizers, Recycling, Poultry, Feeds.
Identifiers: Refeeding, Dried Poultry Wastes.

The Poultry Science Department at Michigan State University has concluded that dehydration of raw poultry manure holds the greatest potential for reducing odor and other forms of pollution while rendering a reusable product. In a yet unfinished test begun in late 1970, commercially-grown pullets are fed on mixtures of 12½ percent dried poultry waste (DPW) and 87½ percent corn, 25 percent DPW and 75 percent corn, or 100 percent corn. Up through the twenty-second pass the usable protein was running at a fairly constant 10 percent, the mortality rates were about the same for all three groups, and the production of eggs was slightly, although insignificantly, in favor of the corn birds. The possibility of seasonable influences is being further investigated. The non-odorous DPW also has potential as a fertilizer for lawns, athletic fields, golf courses, greenhouses, and potted house plants. (Solid Waste Information System)

### 3212 - A10, B1, F3
### FINAL REPORT - MANURE HANDLING AS RELATED TO FLY (HOUSE AND/OR STABLE) CONTROL PROJECT 1763,

W. L. Gojmerac
Final Report—Project 1763, College of Agricultural and Life Sciences, University of Wisconsin, 1972, 12 p. 3 ref.

Descriptors: Wisconsin, Lime, Automation.
Identifiers: Fly control, Manure, Bedding, Slatted floors.

Recent technology has added a new dimension to fly-control in farm sanitation programs. Summer feeding, automated equipment that is not self-cleaning, slatted floors, etc. can retain manure or feed which breeds flies. In 1971 and 1972 several farms in Wisconsin were inspected and studied to observe causes, major problems and possible solutions to fly infestation of manure. Variables that were investigated that could affect fly-breeding in relation to manure were: (1) bedding, (2) the effectiveness of lime treatment, (3) old manure, (4) allowing chickens to run and work manure stocks, and (5) location of fly maggots in a production unit. Investigation of farms showed that house fly numbers were reduced by not using any bedding. Lime was not found to be a practical method for fly control. Problem areas of fly infestation were found to be: (1) between slats or slatted floor operations, (2) in and around sprockets, gears, chains, and other machinery parts where manure accumulates, (3) in the crust formed on liquid tanks and detention ponds, (4) during the exercise year, anywhere animal traffic tends to be light, and (5) liquid manure pits. The season during which flies were the most prevalent was the summer. Areas needing further investigation are listed. (Penrod-East Central)

### 3213 - A8, A11, B1, C2, E2, F5
### FERTILIZER: ANIMAL HEALTH PROBLEMS AND PASTURE FERTILIZATION WITH POULTRY LITTER,

S. R. Wilkinson and J. A. Stuedemann
McGraw-Hill Yearbook of Science and Technology, McGraw-Hill Book Company, Inc., 1974, p. 180-182. 2 fig, 4 ref.

Descriptors: Fertilizers, Litters, Cattle, Toxicity, Nitrogen herbage.
Identifiers: Land disposal, Poultry wastes, Fat necrosis, Grass tetany.

The occurrence of fat necrosis, grass tetany, and nitrate toxicity in cattle grazing fescue pastures heavily fertilized with poultry litter has mobilized researchers to investigate the application and effects of poultry litter on grazing land. Fat necrosis, referred to as lipomatosis, is the presence of hard fat masses in the abdominal cavity. Digestive disturbance, scanty feces, bloating, and difficult birth are some of the symptoms associated with fat necrosis. Fat necrosis has been investigated in Kentucky-31 tall fescue pastures fertilized over a several-year period with different amounts of nitrogen in the poultry litter. Fat necrosis free cattle that were introduced to the pasturage soon suffered rectally palpable lesions that increased with time in size and number. The results indicated that incidence of fat necrosis was related to high nitrogen fertilization of fescue pastures rather than feed additives in the poultry litter. Grass tetany is a complex nutritional disease associated with low blood magnesium levels. Cattle producers in areas of concentrated poultry production have reported an increase in the incidence of grass tetany. Nitrogen and potassium inputs increase herbage nitrogen and potassium. When such herbage is ingested by the tetany susceptible cow, the possibility of grass tetany is increased. It has been found that magnesium oxide in amounts of 1.5 to 2 ounces per cow added to feed will prevent grass tetany. Excessive nitrate concentrations in herbage has also been attributed with causing some cattle losses. Although the problem of nitrate toxicity is complex, some factors that affect the accumulation of nitrate are: (1) excessive nitrogen fertilization, (2) drought, (3) cloudy weather, (4) herbicides, (5) imbalance of soil nutrients, (6) kind of plant, (7) age of plant, and (8) plant part. Control of health problems such as these may depend upon the sensible use of poultry litter and good pasture management. (Penrod-East Central)

### 3214 - B2, D3, E3
### METHANE GENERATION FROM LIVESTOCK WASTES IN NORTHERN GEORGIA,

Agricultural Engineering Department, Georgia University, Coastal Plains Experiment Station, Tifton
C. V. Booram, G. L. Newton, and F. Haley
Presented at 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 4543, 8 p. 3 fig, 2 tab.

Descriptors: Methane, Georgia, Design, Lagoon, Irrigation.
Identifiers: Anaerobic digester, Swine.

This paper describes an on-farm anaerobic digester near Canton, Georgia. At Fred Haley Farms, Inc. wastes are produced by three separate swine units located near the anaerobic digester. The first unit is a boar test facility which contains 230 animals at any one time with each animal in an individual pen. Both sides of the building are open and ventilation depends on natural air movement; the floor is partially slatted. Wood chips are used for bedding. Once a day, manure is hydraulically transported out of the building using dosing siphons as the mechanism for the release of fresh water. Unit 2 is a farrowing unit with a maximum capacity of 48 sows. Wastes are hosed out of the partially slatted building daily. Unit 3 is a 250 head confinement building where wastes are scraped daily into an open channel located at the side of the building. Twice a week, the manure in this channel is flushed into the digester. The digester is 24 feet in diameter with a maximum fluid depth of 19 ft. and has an operating volume of 8600 cu. ft. or 65,000 gallons. The gas produced is piped into the farrowing unit to be used for heating during the winter. A maximum of 665 $ft^3$ of gas per day or about 14,900 BTU's per hour are produced in the digester. Effluent from the digester is discharged into a lagoon and kept for use in irrigation. (Edwards-East Central)

### 3215 - A11, B1, C2, E3
### MINNESOTA LAMB TRIALS SHOW POORER GAINS WITH POULTRY WASTE THAN CORN-SOY,

Anonymous
Feedstuffs, Vol. 48, No. 15, p. 24, 29-31, April 12, 1976. 6 tab.

Descriptors: Feeds, Performance, Nitrogen, Energy, Litters, Sheep.
Identifiers: Poultry wastes, Refeeding.

At the University of Minnesota a study was done to explore the possibilities of using the tremendous amounts of turkey litter as a nitrogen and energy roughage source for lambs. This poultry wastage was pelleted (¼" pellets). The poultry wastage or litter was basically wood shavings with a bit of rice hulls upon which 3 groups of turkeys were fed. The material going to the dehydrator was 25-30 percent moisture. To determine its value as a source of nitrogen and possible energy as well, 6 lots of 12 lambs each were fed the following concentrate mixtures: (1) control-corn 85 percent, soybean meal (SBM) 15 percent, (2) corn 70 percent, poultry wastage 30 percent, (3) corn 60 percent, poultry wastage 40 percent, (4) corn 80 percent, SBM 20 percent, (5) corn 50 percent, poultry wastage 50 percent, and (6) corn 40 percent, poultry wastage 60 percent. Results showed that initially the lambs showed no reluctance to consume the pelleted poultry wastage. Daily protein intake per lamb in lots 1, 2, and 3 was about equal and in all cases exceeded requirements. Higher but equivalent "protein" levels were provided to lambs in lots 4, 5, and 6. It appears that the weight gain data were a direct reflection of energy intake. While the poultry wastage contained 280 ppm copper, the researchers experienced no difficulty with copper toxicity. Also studied were: whether pelleted beet pulp could be used advantageously in finishing rations for lambs, feeding cull navy beans to study their value as a sheep feed, the effect of forage species and grazing management on lamb production and grain feeding lactating ewes. (Rowe-East Central)

### 3216 - B1, B2, B3, B4, C2, E3
### MANURE SYSTEM NEEDS FIRST PRIORITY IN CONFINEMENT PLANNING,

Anonymous
Beef, Vol. 12, No. 5, p. 6, 10-11, January, 1976. 4 fig.

Descriptors: Confinement pens, Design, Waste storage, Equipment, Nutrients, Lagoons.
Identifiers: Waste management.

Planning a complete manure handling system before building a confinement barn can save countless headaches. The most common problems of poor planning are: (1) too small lagoons or storage pits, (2) inadequate agitation equipment, (3) inadequate ventilation, (4) top filling lagoons, (5) lagoons built without any thought of an alternative handling system, (6) odors, and (7) freezeups. The most common problems caused by management errors are: (1) undersized removal equipment, (2) insufficient water in lagoons, (3) improper agitation of manure pits, (4) build-up of solids in the bottom of the pit, (5) bedding in the manure, (6) insufficient animal traffic on the slotted floors. Bob Maddex, Michigan State agricultural engineer says to "plan your system first - then pick a building to match that system." A checklist for evaluating manure systems is given. There are four different areas in planning a manure handling system which one must contemplate very seriously. They are: (1) type of system, (2) method of collection, (3) storage and (4) utilization equipment. Proper handling and storage is also important if the manure is to be used for fertilizer because of the effect that handling and storage has on the value of the manure. Several ways of preventing losses of nutrients from the manure are also mentioned. James Moore, University of Minnesota engineer, said there are 4 rules to be followed by owners of liquid manure lagoons: (1) start the lagoon with ample amounts of water, (2) start the lagoon in warm weather to work the "bugs" out before winter, (3) do not overload the lagoon, and (4) withdraw liquid annually. (Edwards-East Central)

### 3217 - B1, C2, E3
### MANURE VALUE NEXT TO EGGS IN EGG PRODUCTION,

Poultry Digest, Vol. 35, No. 406, p. 74, February, 1976.

Descriptors: Nutrients, Fertilizers, Economics, Nitrogen, Phosphorus, Potassium.
Identifiers: Poultry manure.

Edward C. Naber, Ohio State University, says that poultry manure is the second most valuable product produced in an egg operation. Wholesale value of nitrogen is 18¢ a lb.; phosphorus, 38¢ a lb.; and potassium, 8¢ a lb. Each hen has annual output of about 80 pounds of manure having about 40 percent moisture when removed from the house. On the basis of this fact, it is calculated a hen produces between $1 and $1.20 worth of fertilizer elements a year. Naber says that poultry men must take advantage of the economic value of poultry manure. (Edwards-East Central)

### 3218 - B1, D3, E3, F1, F6
### CORNELL TEAM WORKING ON ANIMAL WASTE DIGESTER,

Feedstuffs, Vol. 48, No. 34, p. 42, August 23, 1976.

Descriptors: Recycling, Methane, Feeds, Fertilizers, Nutrients, Costs.
Identifiers: Refeeding, Digester.

A grant-funded three-year project is underway at Cornell University to develop a waste digester capable of producing methane gas as well as fertilizers and protein-rich feedstuffs from cow manure. The proposed digester will produce methane gas, and at the same time will recover nitrogen in ammonia form, phosphorus and potassium from wastes. Also, bacteria in the waste will be harvested as a basic material for animal feeds. The processed waste, an odorless material, will be suitable for use in home gardens and for improvement of soil properties. Another digester to produce only methane will also be designed. It will be for use on dairy farms with as few as 20 cows. The main objective of Cornell's study is to develop lower cost energy generation systems. (Rowe-East Central)

### 3219 - A3, A8, B3, C2, E2
### MANURE EFFECTS ON RATE OF ADVANCE, INTAKE, AND QUALITY OF RUNOFF FROM IRRIGATED PULLMAN CLAY LOAM,

Soil Scientist, USDA Southwestern Great Plains Research Center, Bushland, Texas 79012
A. C. Mathers, B. A. Stewart, and J. D. Thomas
Unpublished paper, Soil, Water, and Air Sciences, Southern Region, Agricultural Research Service, U.S. Department of Agriculture and Texas Agricultural Experiment Station, Texas A&M University, 1975, 18 p. 1 fig, 7 tab, 12 ref.

Descriptors: Agricultural runoff, Irrigation, Crop response, Nitrates, Phosphorus, Chlorides, Sorghum.

At the USDA Southwestern Great Plains Research Center, Bushland, Texas, manure was incorporated into Pullman clay loam. Manure treatments of 0, 22, and 67 metric tons / hectare were applied annually. Additional treatments of 67 / ha were applied the first year only and 22 kgN / ha was applied annually. Grain sorghum was grown and irrigated. It was found that manure applications slowed the advance rate of irrigation water in graded furrows and increased intake rates. Increased grain yields of plots receiving manure over those receiving N was attributed to more available water. Incorporation of manure in soil did not significantly increase $NO_3$ or Cl in runoff except when rain fell on saturated soil. Phosphorus in runoff was low in all measurements. These data indicate that runoff quality is not markedly reduced when manure is incorporated into soil. (Edwards-East Central)

### 3220 - A3, A8, B3, E2

### EFFECT OF WINTER APPLIED MANURE ON RUNOFF, EROSION AND NUTRIENT MOVEMENT,

Agricultural Engineer, U. S. Department of Agriculture, Agricultural Research Service, Morris, Minnesota
R. A. Young
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, June, 1976, Paper No. 76-2080, 9 p. 1 fig, 9 tab.

Descriptors: Agricultural runoff, Erosion, Oats, Alfalfa, Corn, Sampling.
Identifiers: Land application, Application rates, Frozen ground.

A study was set up to determine the contribution of manure applied on frozen ground to the annual nutrient losses associated with runoff and erosion from plowed corn ground and hayland. Eight experimental plots, 4.1 m wide and 23.4 m long, were set up on a 9 percent slope on Barnes Loam (Udic Haploborall) in west central Minnesota. Four of the plots were planted in corn, 2 in newly seeded alfalfa with an oat cover crop, and the remaining 2 were left in 6-year-old alfalfa. Treatments on the 8 plots consisted of the following: CORN — (1) check, no manure, (2) 44.8 metric tons/ha solid dairy manure, wet basis, applied in fall and plowed under, (3) 44.8 metric tons/ha solid dairy manure, wet basis, applied in fall on frozen ground, (4) 44.8 metric tons/ha solid dairy manure, wet basis, applied in spring on top of snow; NEW ALFALFA—(5)44.8 metric tons/solid dairy manure, wet basis, applied in fall on frozen ground, (6) 44.8 metric tons/ha solid dairy manure, wet basis, applied in spring on top of snow; OLD ALFALFA — (7) 44.8 metric tons/ha solid dairy manure, wet basis, applied in fall on frozen ground, (8) 44.8 metric tons/ha solid dairy manure, wet basis, applied in spring on top of snow. Each plot was equipped with runoff measuring equipment for measuring all water and soil coming off the plot surface during runoff events. Soil and nutrient loss from manured plots was lower than expected. The effects of winter manuring extended into the growing season, causing decreased soil loss, runoff, and nutrient movement and increased yields. (Rowe-East Central)

### 3221 - B2, C2, D3, E1, E2

### INTER-RELATIONSHIPS BETWEEN NITROGEN BALANCE, pH AND DISSOLVED OXYGEN IN AN OXIDATION DITCH TREATING FARM ANIMAL WASTE,

Chemistry and Microbiology Divisions, North of Scotland College of Agriculture, Aberdeen
I. Murray, J. W. Parsons and K. Robinson
Water Research, Vol. 9, No. 1, p. 25-30, January, 1975. 4 fig, 1 tab, 15 ref.

Descriptors: Nitrogen, Hydrogen ion concentration, Dissolved oxygen, Nitrification, Denitrification Ammonia.
Identifiers: Oxidation ditch, Land disposal.

Major pathways of nitrogen in aerobic farm waste treatment systems are outlined, and attempts are made to explain the observed data and fate of nitrogen, in terms of the mode of operation of the field scale system. The changes in DO, oxygen uptake rate, pH and nitrogen balance were monitored under steady and nonsteady state conditions in an oxidation ditch treating undiluted pig waste. Undesirable nitrite accumulations occurred in the presence of high levels of free $NH_3$ and $HNO_2$. The influx of raw waste encouraged this self-promoting process. DO and pH were found to be inversely related. High DO was associated with an acid mixed liquor and nitrification. Low DO was associated with high pH and a denitrifying or non-nitrifying mode of operation. Aerobic treatment of concentrated farm waste inevitably results in some degree of nitrification and subsequent nitrogen loss through denitrification when the mixed liquor ceases to be aerobic. This is desirable if the settled liquor is to be discharged to a water course; however, if conservation of nitrogen for land application is required, then the aerobic system is wasteful and the use of nitrification inhibitors would lead to accumulation of $NH_3$ and high pH. (Penrod-East Central)

### 3222 - A8, C2, E2

### EFFECTS OF CATTLE DUNG AND DUNG BETTLE ACTIVITY ON GROWTH OF BEARDLESS WHEATGRASS IN BRITISH COLUMBIA,

Division of Entomology, CSIRO, Private Bag No. 3, Indooroopilly, Queensland 4068, Australia
A. MacQueen and B. Beirne
Canadian Journal of Plant Science, Vol. 55, No. 4, p. 961-967, October, 1975. 3 tab, 23 ref.

Descriptors: Crop response, Productivity, Nutrients, Nitrogen.
Identifiers: Dung beetles, British Columbia, Crude Protein.

This study was conducted to evaluate the effects of adding nitrogen to soil in various ways on the growth of beardless wheatgrass. One of these ways was to use a dung-burying beetle, Onthophagus nuchicornis (L.). The experimental work was done at the Research Station, Agriculture Canada, Kampoops, British Columbia. Beardless wheatgrass was grown in pots containing typical Brown Chernozemic sandy loam soil from severly overgrazed grassland. Six treatments, replicated 10 times were as follows: (1) 200 g of fresh dung hand-mixed with the soil, to stimulate total burial of the dung by beetles, (2) 200 g of fresh dung plus 5 pairs of O. nuchicornis beetles that buried some dung mainly in the form of brood balls to provision their larvae, (3) 200 g unburied fresh dung to stimulate the current rangeland situation where dung normally remains unburied, and (4) a control, where no dung or nitrogen fertilizer was added to the soil. Total incorporation of the fresh dung into the soil increased total crude protein production, potential seed production, and the vigor of the grass over the 2 year period. Burial of an average 37 percent of the available dung by beetles caused a 38 percent increase in crude protein over that of the control. These rangelands have an impoverished native dung beetle fauna in comparison with some other climatically similar areas of the world. Efficient dung beetles should bury cattle dung more effectively during the growing season than do the present species. Establishment of such new species might provide an aid to nutrient recirculation and, through this, to maintenance of rangeland productivity. (Rowe-East Central)

### 3223 - B1, D2, D̄3, E3, F1

### FEEDLOT WASTES TO USEFUL ENERGY — FACT OR FICTION?,

Associate Professor of Civil Engineering, Kansas State University, Manhattan
L. A. Schmid
Journal of the Environmental Engineering Division (Proceedings of ASCE), Vol. 101, No. EE5, p. 787-793, October, 1975. 2 fig, 6 ref.

Descriptors: Energy, Feedlots, Anaerobic digestion, Recycling, Fuels, Fertilizers, Economics.
Identifiers: Case studies.

The present energy shortage makes it necessary for new sources of energy to be sought. One such source is feedlot wastes which can be used to produce gas or other energy. Although the buffalo chips used by early pioneers contained much of their original fuel value, present feedlot conditions make it impossible for wastes to maintain their maximum fuel value and therefore place a restriction on the uses of wastes for fuel. The author's first and last law of energy conservation is: Total energy expended to obtain energy must not exceed return energy. There are several methods of energy conversion, four being (1) conversion to heat by incineration methods; (2) conversion to gas by high temperature pyrolysis; (3) conversion to gas by biological methods; and (4) conversion to other organic forms. Because of the energy lost on present feedlots, all of these methods suffer substantially. Three case studies to examine in detail biological conversion to gas by anaerobic digestion are discussed. The conclusion reached by the author was that net energy production from present feedlots is neither practical or possible, and that the best use of feedlot wastes is as fertilizers. (Edwards-East Central)

### 3224 - C1, C2, E2, E3

### DUNG AS AN ESSENTIAL RESOURCE IN A HIGHLAND PERUVIAN COMMUNITY,

Department of Anthropology, Cornell University, Ithaca, New York
B. Winterhalder, R. Larsen and R. B. Thomas
Human Ecology, Vol. 2, No. 2, p. 89-104, April, 1974. 5 fig, 5 tab, 29 ref.

Descriptors: Recycling, Fuels, Fertilizers, Sheep, Cattle, Energy, Nutrients.
Identifiers: Llamas, Ecology, South America.

In the community studied, dung was used as both fuel and fertilizer. Interestingly enough, native choice among available dungs corresponds to their qualities: sheep dung, richest in nutrients, is applied as fertilizer; llama and cattle dungs, each with a high caloric value, are burned as fuels. The emphasis of the bulk of the paper is on anthropological ecology, using the concepts of energy flow, nutrient cycling and environmental adaptation to demonstrate the importance of efficient use of animal excrement in the adaptation of highland peoples. (Solid Waste Information Retrieval System)

### 3225- -B1, C2, E2, F1

### NUTRIENT CYCLES INVOLVING PHOSPHORUS AND POTASSIUM ON LIVESTOCK FARMS IN NORTHERN IRELAND,

Agricultural and Food Chemistry Department, Queen's University of Belfast, Northern Ireland
S. N. Adams and J. S. V. McAllister
Journal of Agricultural Science, Vol. 85, No. 2, p. 345-349, 1975. 2 fig, 2 tab, 12 ref.

Descriptors: Phosphorus, Potassium, Fertilizer, Economics.
Identifiers: Nutrient balance sheet, Northern Ireland, Land spreading.

The Netherlands Ministry of Agriculture has suggested that the net need of livestock farms for fertilizer P and K can be determined by comparing the P and K produced in the excreta of housed livestock with the needs of the crops grown. This study was done to see if the principle could be used in advising farmers by developing a simple form of nutrient balance sheet to ensure efficient recycling of nutrients, while avoiding deficiencies of excesses. About 100 farms throughout Northern Ireland were selected by the Department of Agriculture's advisory staff to cover the main farming types in the area. The farmers provided records of the stock carried, the area of the crops grown, and the fertilizer used from November 1, 1972 to October 31, 1973. The soils of all fields were sampled for P and K determinations. An arbitrary deduction of 10 percent of the P and K was made to allow for losses from P and K "balances". It was found that the amounts of P and K fertilizers applied on the predominantly grassland farms bore little relation to needs; furthermore, almost all farmers applied more fertilizer than was needed to cover deficits. It was felt that nutrient balances would encourage farmers to regard organic manures as a valuable source of nutrients rather than as a waste product to be disposed of. Furthermore, the nutrient balance sheets are readily understood and could help the farmer make substantial savings in fertilizers. However, the nutrient balance sheet is subject to large errors. (Rowe-East Central)

### 3226 - A4, A6, B2, C2, D3, E2 -

### NORTH CAROLINA SWINE OPERATION SOLVES ODOR, WASTEWATER PROBLEMS

Feedstuffs, Southeastern Correspondent
R. H. Brown
Feedstuffs, Vol. 47, No. 48, p. 34-36, 38, November 24, 1975. 3 fig.

Descriptors: Management, Design, Odor, Wastewater treatment, Aeration, Lagoons, Anaerobic conditions, Irrigation, Denitrification, Oxygen demand, Water pollution, Feedlots, North Carolina.
Identifiers: Swine, Land disposal.

Lexington Swine Breeders, Inc. developed some disposal and odor problems which were compounded by the building of a large furniture factory and several new homes nearby. The manager of Lexington Swine Breeders, Inc., Dr. George Wetherill, secured the assistance of 4 faculty members of North Carolina State University who helped develop a satisfactory waste management system. The plan called for the emptying of 1 of 4 manure pits (1 pit for each swine house) into a newly built aerobic lagoon. Here the odors were eliminated and the oxygen demand, organic carbon, and solids loading were reduced. The wastes then went into an anaerobic lagoon. This aerated-unaerated treatment sequence provided a suitable condition for biological denitrification or nitrogen removal. Since nitrogen is usually the limiting factor in determining the amounts of wastes or wastewaters to be applied to fields, there was great advantage in this. The wastewater was then sprinkler irrigated out on pasture land about 1 ½ hours a week. A creek, which had run through the feedlot, was diverted around the feedlot into a larger creek in order to prevent it from being polluted any longer. The system seems to be working quite effectively. (Rowe-East Central)

## 3227 - B1
### MECHANICAL MANURE HARVESTING FROM FEED-LOTS,

Department of Agricultural Engineering, Colorado State University, Fort Collins 80523
J. D. Kellerby and J. L. Smith
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, Lincoln, June 27-30, 1976, Paper No. 76-3038, 16 p. 11 fig, 1 tab, 3 ref.

Descriptors: Feedlots, Equipment, Design.
Identifiers: Manure harvestor

Study objectives were: (1) to design and build a prototype manure harvester for use on concrete or hard surfaced beef feedlots, (2) to test the manure harvester using wood shavings, wood paste and beef feedlot manure and make practical recommendations for improvement of the machine, and (3) to determine the power required to operate various components of the manure harvester with respect to efficiency of loading, forward speed, variation in speed and position of various machine components and depth of manure. The harvester was constructed on a small modified manure spreader. All components were hydraulically powered. A loader was bolted to the front of a small manure spreader after removal of the front wall. The rear spreader components were removed. The manure harvester operated in this manner. The tracter moved forward. A crustbreaker pulverized the surface and threw the material back into a beater. A scraper blade under the beater cleaned the material to the desired depth. The beater's helical blades cut any large pieces and threw the material back to the inclined conveyor where it was moved up a platform into the harvester bin which was unloaded when full. Study conclusions were: (1) The manure harvester loaded most efficiently from the standpoints of tractor speed, power required, and pulverization, when the material was approximately 5 cm deep and the surface was reasonably smooth. Approximately 40 $m^3$/hr could be loaded and about 75 percent of the material encountered was loaded. (2) At the optimum material depth of 5 cm and tractor speeds ranging from 1 to 2 km/hr, less than 10kW was required to operate the loader. (3) A smooth hard surface was the most desirable feedlot condition. It was observed that the hydraulic motor for the crustbreaker needed increased torque and that the conveyor needed to be redesigned to prevent plugging at the entry. (Rowe-East Central)

## 3228 - E3, F1
### LOTS GET OK TO PRODUCE GAS TO COOK STEAKS.

G. Richardson
Western Livestock Journal, Vol. 54, p. 1, January 5, 1976.

Descriptors: Methane, Feedlots, Recycling, Oklahoma, Texas, Costs.

Natural Gas Pipeline Company of America has been authorized by Judge Israel Convisser to transport and sell methane gas produced by cattle manure. The pipeline company plans to buy the gas from Calorific Recovery Anaerobic Process, Inc. of Oklahoma City at an approved price of $1.33 per 1000 cubic feet. The gas will by produced from a plant which Calorific has under construction close to several feedlots near Hooker, Oklahoma. Completion is scheduled for mid-1976. Natural has also just entered a second agreement to purchase commercial quantities of methane from a generating plant to be built by Ecological Research Associates, Lubbock, Texas, near a feedlot in Deaf Smith County, Texas. Natural hopes to purchase the gas from Ecological Research Associates at a base price of $1.30 per 1000 cubic feet. While the firm notes that the gas produced from cattle manure is higher than current wellhead prices for natural gas, it is "significantly less expensive than other forms of synthetic gas now being developed and lower than the cost of liquified natural gas being imported by some U.S. utilities." The 2 contracts are believed to be the first commercial-volume purchases by an interstate pipeline company of methane gas generated from manure. (Edwards-East Central)

## 3229 - B1, C2, D3, E2, F1
### MANAGE HOG WASTE FOR FERTILIZER VALUE,

Anonymous
Wallaces Farmer, Vol. 101, No. 4, p. 43, February 28, 1976.

Descriptors: Fertilizers, Nutrients, Management, Nitrogen, Phosphorus, Potassium, Economics.
Identifiers: Swine.

Almost 70 percent of the phosphorus and nitrogen and 90 percent of the potassium in swine rations are excreted in wastes. Correct management of these wastes helps conserve these nutrients for fertilizer. Stuart Melvin, Iowa State University extension agricultural engineer, says that in a farrow-to-finish operation, a 220-lb. pig excretes 14-16 lb of elemental nitrogen, 7-8 lb of phosphate, and 3-6 lb of potassium when fed common rations. About 70 percent of these nutrients are excreted when the pig is fed from 40-220 lb. The bedded and deep pit systems are best for conserving nitrogen. Nitrogen losses are highest in aerobic-anaerobic treatment combinations and in anaerobic lagoons. Nitrogen is also lost in the form of ammonia when wastes are field spread. Much phosphorus and potassium are lost in systems having high runoff from outside lots or in sludge buildings in the bottom of lagoons. Fertilizer value per pig marketed varies from $1.50 to $5, depending on the system used. Disposal costs vary from 50c to $2.50 per head marketed. (Edwards-East Central)

## 3230 - B1, F2
### NUISANCE LAW OFFERS FEEDERS PROTECTION,

Anonymous
Wallaces Farmer, Vol. 101, No. 8, p. 20, April 24, 1976.

Descriptors: Legal aspects, Iowa, Costs, Livestock.
Identifiers: Nuisance suits.

A bill being considered by the Iowa legislature would give livestock producers some protection against nuisance suits and changing environmental regulations. The proposed law grew from the belief that present nuisance regulations discourage livestock producers from expanding operations because they fear possible court action which might close them down. It scares livestock men to think that they might invest thousands of dollars in a new livestock facility and then have to defend themselves in court against someone who may build a house next door and then claim the facility a nuisance. The bill (SF 367) states that whoever is there first is right. If the livestock operation was built to meet current environmental regulations and zoning, the operator has a 10-year exemption from major design changes. Such a change is defined as one that would cost more than 2 percent of the facility's value. If the producer has to make a less expensive change to conform to rules on a facility that is less than 10 years old, he would have a year to make changes. Today, livestock sales account for slightly more than 50 percent of Iowa's cash farm receipts. Passage of SF 367 should help encourage Iowa farmers to make the investment to continue livestock programs. (Rowe-East Central)

## 3231 - A11, B1, C2, E3
### MEDICINAL DRUG RESIDUES IN BROILER LITTER AND TISSUES FROM CATTLE FED LITTER,

Virginia Polytechnic Institute and State University, Blacksburg 24061
K. E. Webb, Jr. and J. P. Fontenot
Journal of Animal Science, Vol. 41, No. 4, p. 1212-1217, October, 1975. 3 tab, 32 ref.

Descriptors: Litters, Virginia, Cattle
Identifiers: Drug residues, Tissue accumulations, Refeeding, Animal health.

An evaluation was made of the degree of broiler litter contamination by drug residues and the effect of feeding broiler litter containing drug residues on tissue accumulation in cattle. Samples of broiler litter were obtained from several houses in the main broiler producing areas of Virginia. The samples were analyzed for oxytetracycline, chlortetracycline, penicillin, neomycin, zinc bacitracin, nicarbazin, amprolium, furazolidone, arsenic and copper. The only drug residues not detected in the litters were neomycin and zinc bacitracin. In the feeding trials, Longissimus muscle, liver and kidney fat samples were tested for drug residues. Chlortetracycline, amprolium, nicarbazin, arsenic and copper assays were conducted on the samples. Low-level chlortetracycline, amprolium, nicarbazin, arsenic and copper assays were conducted on the samples. Low-level chlortetracycline residues were observed in kidney fat from 3 of 20 animals fed litter. Arsenic residues in muscle and liver increased as the amount of litter fed increased. Litter feeding resulted in copper accumulation in the liver. Amprolium or nicarbazin residues were not detected. The study thus indicated that drug residues are commonly found in broiler litter, but that feeding litter to cattle results in little or no drug accumulation in tissues tested after a 5-day withdrawal of litter. (Rowe-East Central)

## 3232 - A2, A4, A12, C3
### FAECAL COLIFORMS AND FAECAL STREPTOCOCCI IN STREAMS IN THE NEW GUINEA HIGHLANDS,

Department of Civil Engineering, University of Birmingham, P.O. Box 363, Birmingham B 15 2TT
R. Feachem
Water Research, Vol. 8, No. 2, p. 367-374, June, 1974.

Descriptors: Water pollution, Coliforms, Streptococcus, Public health, Agricultural runoff.
Identifiers: New Guinea, Swine, Domestic water sources, Pollution indicators.

A detailed study was made of fecal coliform and fecal streptococci concentrations in the streams of the Saka Valley in the Highlands of New Guinea. The Saka Valley supports large populations of humans and domestic pigs, whose feces are washed into the streams by surface runoff following rain. Researchers hoped to determine whether the fecal content of the streams, which are used as domestic water sources, would render the waters unsafe. If so, the researchers further wanted to determine what action could be taken to minimize this hazard. Study conclusions were: (1) Natural waters in the New Guinea Highlands are contaminated with fecal material, which may derive largely from herds of domestic pigs. (2) The polluted waters are used for all domestic water needs and are a health hazard. Only the spring water is of reasonable quality and the encouragement of greater use of spring water, and spring protection, are obvious public health improvement measures. (3) Fecal coliforms and fecal streptococci proved to be excellent indicators of fecal pollution in the New Guinea Highlands. The membrane filtration techniques, used to enumerate these bacteria, were highly suited to the remote field conditions and the primitive laboratory. (4) Fecal streptococci concentrations were extremely sensitive to animal pollution and peaked rapidly following stormwater runoff into the streams. (5) Water temperatures ranged from 13 to 26.2 degrees C and there was no evidence of coliform regrowth at these temperatures. This may be due to the absence of major discharges of domestic or industrial wastes into the streams. (Rowe-East Central)

## 3233 - A12, B1

### THE $446,700 BIT OF ADVICE: DON'T SWIM IN THE MANURE PIT!

J. Richter

Beef, Vol. 12, No. 12, p. 55, August, 1976.

Descriptors: Feedlots, Safety.
Identifiers: Occupational Safety and Health Administration.

The Occupational Safety and Health Administration (OSHA) of the U. S. Department of Labor published a booklet entitled "Safety with Feed Cattle" which caused a real battle between bureaucrats and beef producers. Beef producers, however, are emerging from the field without a visible scratch to reap a just reward — a measure of relief from the rules and meddlesome ways of OSHA. Congressman Tom Hagedorn of Minnesota, noting that the pamphlet was one in a series of OSHA pamphlets which would cost taxpayers an estimated $466,700, said: "The material in these pamphlets seems to be written for a New Yorker about to visit a farm for the first time... I can't believe these (booklets) are intended for persons who have spent all their lives on farms." The feedback got through to Washington, and the Assistant Secretary of Labor Morton Corn, who runs OSHA, announced that distribution of the booklet was being halted "pending its revision." A compromise between the House and Senate on the number of ranches and farms to be let off the hook seems to be in the making. (Rowe-East Central)

## 3234 - B2, B4, F1

### HOW THEY HANDLE FREE STALL MANURE,

Anonymous

Hoard's Dairyman, Vol. 121, No. 1, p. 12-13, 46-47, January 10, 1976. 5 fig.

Descriptors: Waste storage, Design, Costs, Equipment, Dairy management.
Identifiers: Waste management, Free stall manure.

In a round table discussion, Michigan, Vermont, and Wisconsin dairymen told how they handle their free stall manure. The 4 men contributing to the discussion were: E. Budd Gerrits, Wisconsin; Erwin Walker, Wisconsin; Tom Howlett, Vermont; and Jerry Cameron, Michigan. Waste storage was handled on each man's dairy as follows: Gerrits—earthen basin; Walker—silo; Howlett—earthen basin; and Cameron—earthen basin. Equipment, materials, and total costs for each system were as follows: Gerrits—alley scrapers, barn cleaner, transfer pump, dock on pond, excavation and concrete, pump and spreader; Total cost—$21,000; Walker—transfer pump in lot, silo and pump, 3,000 gallon spreader; Total cost—$19,500; Howlett—all weather road, excavation, pump, truck-mounted tank, and trailer-mounted spreader; Total cost—$18,000; Cameron—barn cleaner, garden tractor, excavation and picket dam, side-unloading spreader, box spreader and tractor loader; Total cost $12,147. When asked what changes they would make if they could plan each system over again, their replies were as follows. Gerrits said he would slope the bottom of the earthen basin more and possibly concrete the bottom of it. He would also have his underground pipe from the barn be either level or down hill. Walker didn't have any changes. Howlett recommended making the basin lower than the barn to allow for gravity flow. He also recommended a trailer-mounted pump with a 30-foot high pole which would enable the tractor to stay on the level at the top of the pond. Cameron could think of no changes that should be made. (Rowe-East Central)

## 3235 - B1, D3, E3

### METHANE PRODUCTION FROM MANURE IS TODAY'S REALITY IN FLORIDA,

Calf News, Vol. 14, No. 4, p. 48, April, 1976.

Descriptors: Methane, Recycling.
Identifiers: Anaerobic fermentation, Kaplan Feedyards, Refeeding.

Kaplan Feedyards of Bartow, Florida, may be the first feedyard to commercially produce methane gas according to Don Kaplan. They built a waste conversion system for an 8,000-head feedyard. The anaerobic fermentation process will produce 60 million BTU's per year and 2,900 tons of a 25 percent protein feed product. Kaplan plans to use the methane to power the boilers in his packing plant. (Rowe-East Central)

## 3236 - A7, B1

### PIT VENTILATION SYSTEM FOR SWINE BUILDING,

Agricultural Engineering Department, Illinois University at Urbana-Champaign

R. A. Keller and D. L. Day

Presented at 1975 Annual Meeting, American Society of Agricultural Engineers, University of California, June 22-25, 1975, Paper No. 75-4048, 14 p. 9 fig, 7 tab, 9 ref.

Descriptors: Design.
Identifiers: Swine buildings, Slatted floors.

A ventilation system for exhausting air from manure pits was installed in a hog-finishing building with a partially slatted floor at the Illinois Agricultural Experiment Station and its operation was monitored during the winter of 1964-1965. Air was exhausted from the manure pit through a 4-inch diameter PVC sewer pipe. The building was insulated on the ceiling, but the walls were not insulated and the doors along the walls were not closed completely in certain locations; thus temperature differences and drafts were noticable. Although smoke tests revealed a downward air flow at the slat level, the percent of slat area was not large enough to determine all the effects from the pit ventilation system. The design and installation of this system can be adapted to fit any building. (Edwards - East Central)

## 3237 - A6, B2, C2, D3, E2

### HATCHERY INSTALLS NEW WASTE MANAGEMENT SYSTEM, WAITS RESULTS,

Feedstuffs Southeastern Correspondent

R. H. Brown

Feedstuffs, Vol. 48, No. 30, p. 52-53, July 26, 1976. 2 fig.

Descriptors: Management, Design, Wastewater treatment, Wastewater disposal, Lagoons, Sprinkler irrigation, Odor, Chemical oxygen demand, Nitrogen.
Identifiers: Hatchery, Land disposal.

A North Carolina hatchery, Chick Sales, Inc., Siler City, has installed a waste management system that is hoped to meet 1985 environmental standards. Scattered over the 23 acres that adjoin the hatchery, the waste management system includes washroom water, egg shells, and no-hatch eggs. The system generates little or no odor. Basically the facility involves a series of treatments in a separator-grinder in the washroom, an aerated lagoon and a second reservoir known as the "polishing" pond. Water goes through these various stages before being put into a sprinkler irrigation system which disperses the waste water and fertilizes fescue during cold weather periods and Bermuda grass during summer growing periods. Cattle graze on the 15 acres of fescue and 8 acres of Bermuda. Maintenance of the system has not been much problem. Most of the time is spent on walking around the lagoons and inspecting the pump and aerators. Hatchery manager, Gail Phillips, also spends part of this time keeping records, primarily for researchers at North Carolina State University who are still studying the system. (Rowe-East Central)

## 3238 - A6, B1, C2, D1, D2, D3, E2

### METHODS OF TREATING ODORS,

C. L. Barth and D. T. Hill

Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, June 27-30, 1976, Paper No. 76-4015, 13 p. 7 tab, 7 ref.

Descriptors: Ammonia, Hydrogen sulfide, Ozone.
Identifiers: Odor control, Methylamine, Land spreading.

Two basic approaches for odor control are: (1) Prevent odor production. This requires establishing conditions which are unfavorable for anaerobic bacterial growth. (2) Treat the odor after it is produced. Drying, refrigeration, aeration, oxidation, the use of absorptive and absorptive chemicals, and the use of masking agents, counteracting agents, deodorants, and enzyme and bacterial cultures are all means of controlling odor. A test was made using 3 of the main odorants in manure — ammonia, hydrogen sulfide, and methylamine — in concentrations that might be expected to be found in livestock production units. Tests were made of the strength of these odorants in various combinations and the effect of ozone in reducing their strengths. Most tests showed that ozone ($0_3$) was effective in reducing the concentration of each odorant with time. However, the reaction time was not as fast as had been previously reported. A surprise reaction was that when $0_3$ was tested against methylamine, it was found that when the dosage of $0_3$ increased and as the time increased, the odor strength also increased. Practical planning and operating practices can help control odor. The livestock owner should: (1) select building sites that are one-half mile from neighboring residences or a mile from communities, schools, institutions or places of employment, (2) try to locate production facilities so that prevailing winds blow odors away from the nearest residents, and (3) use sites that have adequate slopes or sites where slopes can be built for good drainage. Land spreading, a source of odor, should be carefully controlled. Odor problems may be minimized by (1) spreading on a cool day, (2) spreading when the wind is in a favorable direction, (3) spreading early in the day, (4) avoiding spreading just before weekends and holidays, (5) avoiding spreading near highways, homes, schools, or places where people work, and (6) incorporating, the manure into the soils as quickly as possible. (Edwards-East Central)

## 3239 - A8, E2

### THE INFLUENCE OF APPLIED PHOSPHORUS, MANURE, OR LIME ON UPTAKE OF LEAD FROM SOIL,

Department of Botany and Plant Pathology, Colorado State University, Ft. Collins.

R. L. Zimdahl and J. M. Foster

Journal of Environmental Quality, Vol. 5, No. 1, p. 31-34, January-March, 1976. 17 ref.

Descriptors: Lead, Soil contamination, Crop response, Phosphorus, Hydrogen ion concentration.
Identifiers: Land application, Liming.

A study was conducted at Colorado State University, Fort Collins, to determine the effects of phosphorus, organic matter, and pH on uptake of lead by corn (Zea Mays L.). The corn was grown in soil that was contaminated at levels that may be encountered in some agricultural areas. Except for the pH experiment, a sandy clay loam soil of the mallisol order, with 58 percent sand, 17 percent silt, 25 percent clay, and 1.3 percent organic matter, a pH of 7.9 a cation exchange capacity of 13.8 meq/100 g, and a native lead content of 6.4 ug/g was used. All experiments were conducted in 6 replications with 1 corn variety. The experimenters determined that while phosphorus applications decrease lead uptake, translocation is affected and at higher lead levels. Also, addition of phosphorus has not proved to be economically or ecologically feasible. It was found that lead uptake decreases when cow manure is added to attain a total organic content of 6 percent, but there is no effect of additional manure. Liming does not have a consistent effect on uptake, but lead translocation does appear to decrease with liming. (Penrod-East Central)

### 3240 - B1, D3, E3, F1
### METHANE GENERATION FROM AGRICULTURAL WASTES: REVIEW OF CONCEPT AND FUTURE APPLICATIONS,

Cornell University, Ithaca, New York.
W. J. Jewell, G. R. Morris, D. R. Price, W. W. Gunkel, D. W. Williams, and R. C. Loehr
Presented at 1974 Northeast Regional Meeting, American Society of Agricultural Engineers, West Virginia University, August 18-21, 1974, Paper No. NA74-107, 30 p. 7 fig, 5 tab, 27 ref.

Descriptors: Methane, Fermentation, Anaerobic digestion, Costs, Dairy industry, Recycling, Fertilizers, Energy.
Identifiers: Poultry.

Study objectives were: (1) to review the status of anaerobic fermentation in converting organics to methane gas, (2) to approximate the size of animal production operations which could utilize this technology on an economical basis and (3) to project possible future applications of this technology. Advantages of anaerobic digestion were found to be: (1) production of more easily dewatered sludge, (2) odor free sludge, (3) sludge with undiminished fertilizer value, (4) particulate matter in sludge suitable for refeeding, (5) reduction of organic content by 50 percent which prepared the sludge for ultimate disposal, (6) production of a large amount of methane gas as a by-product, and (7) possible reduction of pathogenic organisms. Disadvantages were: (1) explosion possibilities, (2) high capital cost, (3) sensitive to operation and difficult to control, (4) developed much more waste volume to be handled, (5) generated potential water pollution problem, and (6) energy required in terms of heat input. The most serious anaerobic digestion limitation appeared to be ammonia toxicity to the biological mass and may be avoided by controlling the digester loading rate. A gross economic analysis indicated that dairy and poultry farms of 155 and 5200 animals, respectively, could obtain total energy and residue fertilizer benefits equal to the cost of the waste handling system. In the future, this system may provide more than 95 percent of the energy requirements in large broiler operations. Anaerobic fermentation offers promise in conversion of animal wastes to usable energy, conserving fertilizer value equal to the energy value of the methane, and may be useful in large scale energy generation schemes. (Rowe-East Central)

### 3241 - A4, A7, A8, A11, A12, B1, B2, B4, C2, C3, D1, D2, D3, E1, F4
### PROGRESS IN ANIMAL HYGIENE,

University of Veterinary Science, Budapest, Hungary
R. Kovacs and P. Rafai, eds.
Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademiai, Kiado, 1975. 501 p.

Descriptors: Liquid wastes, Cattle, Poultry, Dairy industry, Air pollution, Soil contamination, Water pollution.
Identifiers: Waste management, Hygiene, Animal health, Disinfection, Swine, Bioclimatology, Mastitis, Lambs, Pathogens.

This book consists of papers presented at the First International Congress for Animal Hygiene, Budapest, Hungary, on October 2-5, 1973. A total of 105 papers, chiefly research reports dealing with 9 main topics, were read and discussed. Topics covered were: (1) Disposal, treatment and utilization of liquid manure, (2) Disinfection in large scale management systems, (3) Hygienic problems of large scale cattle husbandry, (4) Hygienic problems of large scale poultry husbandry, (5) Hygiene of feeding, (6) Hygienic problems of large scale swine husbandry, (7) Bioclimatology, (8) Influence of stable hygiene on milk production and incidence of mastitis, and (9) Calf rearing, calf fattening, and lamb fattening. (Merryman-East Central)

### 3242 - A4, A5, A6, A8, A11, A12, B2, C3, D1, D2, D3, E2
### HYGIENIC PROBLEMS OF DISPOSAL, TREATMENT AND UTILIZATION OF LIQUID MANURE,

University of Hohenheim, Stuttgart-Hohenheim, German Federal Republic
D. Strauch
In: Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademiai Kiado, 1975. p. 33-36.

Descriptors: Liquid wastes, Waste treatment, Waste disposal, Aeration, Water pollution, Groundwater pollution, Crop response, Electrolysis.
Identifiers: Hygiene, Pathogens, Land disposal, Radioactive irradiation.

In modern agriculture, excrements of animals are produced mostly as liquid manure. From the hygienic point of view, the main difference from solid manure is the lack of self-heating so that a very important influence on pathogenic microorganisms is absent. Therefore, the liquid manure must be disinfected in the livestock production unit to prevent pathogens from being carried out of the production site. This is often done by means of chemical disinfectants, but care must be taken in using them. Such chemical disinfectants as caustic soda and chlorinated lime will cause damage to plants and therefore prevent the liquid manure from being used as fertilizer. Also, despite the availability of disinfectants for treatment of slurry, most known disinfectants have the disadvantage that there is none with a universal effect. Other methods of treatment that are being utilized involve electric current (ie. radioactive irradiation and electrolysis) and aeration (ie. surface aeration and the ventilating process). Most of these systems are based on the fundamental principle of separating liquid from solid phase. Such separation is not satisfactory from the hygienic point of view as long as the pathogenic microorganisms are not destroyed. Other problems associated with these waste management systems arise with collecting and spreading slurry. Odor is a particular problem at these times, especially from pigs and poultry. Various methods of deodorization by biological, chemical or technical means are being investigated. Final statements cannot yet be made. The problem of residues of chemical deodorants in the organs of animals requires special attention. Also, the question of soil and plant tolerance for large amounts of slurry is being extensively studied. It is known that fertility of the soil is damaged by large amounts of liquid manure. Large doses of slurry also cause a very heavy leaking of $NO_3$ into the groundwaters. (Merryman-East Central)

### 3243 - A8, B2, B3, B4, C2, D3, E2, E3
### ANALYSIS OF LIQUID MANURE TREATMENT IN HUNGARY, WITH SPECIAL REGARD TO ENVIRONMENTAL PROTECTION,

Research Institute for Management of Water Supplies, Budapest, Hungary
L. Vermes
In: Progress in Animal Hygiene, F. Kovacs and P Rafai, (Ed). Budapest, Akademiai Kiado, 1975. p 37-39. 1 tab.

Descriptors: Liquid wastes, Waste treatment, Waste storage, Waste disposal, Fertilizers, Irrigation.
Identifiers: Hungary, Land disposal, Hygiene, Fish farming.

In Hungary, the general tendency has been the agricultural utilization of as much liquid manure as possible, or at least its disposal into the soil, but attempts have also been made at its purification. Agricultural utilization may be accomplished by fertilization of land or use in farm ponds to grow fish. Promising results of the latter warrant further study. The liquid manure may be utilized either after separation of liquid and solid phase or without separation of the phases. If the liquid manure is separated, the solid and liquid phases are treated distinctly. The solids phase is deposited and later used for dunging; the liquid phase is stored for a given time and then carried to the fields or disposed of in another way. Separation of liquid manure is sometimes omitted in order to preserve the manure's valuable components as much as possible until utilization. In Hungary, purification of liquid manure has been attempted unsuccessfully in 2 units — the Pasveer-type oxidation ditch and a combined mechanical-chemical-biological procedure. Chemical analysis of liquid manure has revealed it to be a dangerous water pollutant. Analysis has also showed that liquid manures contain important plant nutrients and thus are valuable fertilizers. In view of the requirements of water quality and environmental protection, direct disposal of liquid manure into the soil under well controlled conditions would appear to be the most feasible waste management method. Transport to the fields should take place in the shortest possible time, by the shortest route, and under consideration of the capacity of the soil so that its fertility may be maintained as long as possible. The use of homogenated liquid manure for continuous irrigation meets not only the hygienic requirements but it is also profitable from the agricultural point of view. The separated liquid phase can be utilized in the same manner if appropriate facilities can be provided for its all-the-year-round storage with due consideration of the hygienic requirements, also under the conditions of quarantenization. (Merryman-East Central)

### 3244 - A11, A12, B2, C3
### SOME BACTERIOLOGICAL CHARACTERISTICS OF SEWAGE AND SLURRY FROM LARGE SCALE SWINE UNITS,

Agricultural College, Institute for Animal Hygiene, Timisoara, Roumania
V. Tomescu, F. Marschang, R. Mora-Minzat, O. Rusu, E. Crainiceanu, and I. Grozav
In: Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademiai Kiado, 1975. p. 40-44. 1 tab, 16 ref.

Descriptors: Bacteria, Slurries, Irrigation, Fertilizers, Sampling, Liquid manure, Pathogenic bacteria.
Identifiers: Swine, Roumania.

Only limited investigations have been carried out in Roumania recently into the bacteriological characteristics of sewage from animal units, especially from large swine farms. Since such sewage is employed for irrigation and the slurry is used as fertilizer, investigations centered on its epidemiological and epizootological role. During 1971, 1972 and 1973, 159 samples of sewage and slurry were taken from 5 large-scale units and 2 swine farms. Bacteriological tests were performed for (a) determination of total germ count per ml of sewage, (b) determination of the E. coli- index, (c) typing of E. coli isolates, (d) detection of salmonellas, and (e) detection of leptospires. Sewage and slurry samples from swine units were found to contain a heavy bacterial load. 142 strains of E. coli, belonging to 23 serogroups, and serogroups pathogenic for humans and animals, were isolated and identified. 106 Salmonella strains, belonging to 12 serotypes were isolated. 32 Leptospira strains were isolated and identified. They were found in 33 percent of the samples collected and in 58 percent of those processed, and belonged to 2 serotypes, 29 to L. pomona and 3 to L tarassovi. The rough and partially purified sewage and the wet settled slurry originating from large pig units and farms have a great potentiality for spreading pathogenic microorganisms, which may have severe epidemiological and epizootological consequences. Purification plants should be properly equipped for the destruction of pathogenic agents in liquid manure and sewage. (Merryman-East Central)

## 3245 - A11, A12, B2, C3, D1, D2, D3, E3, F1, F3

### BACTERIOLOGICAL CONTROL OF EFFICIENCY OF LIQUID MANURE HANDLING,

University of Veterinary Science, Budapest, Hungary
G. Tamasi
In: Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademiai Kiado, 1975. p. 45-51.

Descriptors: Liquid wastes, Bacteria, Waste treatment, Sampling.
Identifiers: Hungary, Waste water reuse.

Examinations were conducted in Hungary to assess the microbiological efficiency of 4 manure handling systems — (1) untreated liquid manure, (2) manure stored in mechanically aerated lagoons, (3) separation of liquid manure into liquid and solid phase by filtration through bundles of straw, and (4) a combined physical-chemical-biological handling system. Total germ count, coliforms, staphylococci, enterococci, and lactobacilli were measured in each of these systems. Treatment in mechanically aerated lagoons was found to be of good microbiological efficiency. In a model experiment, sterile liquid manure was infected with microorganisms isolated from liquid manure, and one sample each was incubated at +4 and +20 °C. The counts of aerobic sporeformers and Salmonella rose in the initial period of incubation at + 20 °C. In another experiment, filtered and purified liquid manure was infected with Salmonella and thereafter was passed through a settling column and a semi-anaerobic bacteriological bed. Germ count determinations in 3 passages showed that this procedure was not in itself sufficient to ensure a salmonella-free end product, but it should be taken into consideration that only the biological conditions were modeled; physical and chemical treatment were not. The authors seemed to feel that recirculation of part of the liquid manure might be beneficial in washing the drains and probably also the floors of fattening houses. This use would reduce the amount to be disposed of by about 30 percent. However, it was recognized that special treatment might need to be performed on the waste water to prevent dangers to human and animal health. Studies will be concerned with disinfection and the fate of microorganisms after the deposition of liquid manure. (Merryman-East Central)

## 3246 - A11, B2

### THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS RELATED TO MANURE HANDLING ON HEALTH OF FATTENING PIGS,

Royal Veterinary College, Skara Division, Skara, Sweden
J. O. Lindqvist
In: Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademiai Kiado, 1975. p. 52-56. 2 fig, 11 ref.

Descriptors: Liquid wastes, Design.
Identifiers: Animal health, Swine, Sweden, Waste management, Housing.

During the last decade, liquid manure handling has been a new alternative in Sweden, especially in the production of fattening pigs. Liquid manure management involves in environment with little or no use of straw. This has led to different animal health problems among purchased pigs, which is usually most evident during the first weeks after installing in the fattening house. In order to reduce the stress for pigs on arrival at the farm, different methods have been tried. For example, the so-called "welcome-stable" is usually a separate room where the total floor is covered by straw, except for the feeding area, which is on an elevated concrete plate. Studies were conducted in a herd of 5,400 fattening pigs in the south of Sweden. On the farm there are two "finishing houses" with 580 fattening pigs in each and 4 "welcome-stables" with 145 purchased pigs in each. The health of the herd was checked by a veterinary surgeon at least 2 times during each rearing period — 10 days after installing the pigs and then 2 months later. A few cases of respiratory disease were recorded. Visible abscesses, localizing in different parts of the body or the legs, were found in 12 pigs. 5-15 percent of the pigs showed injuries from Aarcoptes scabei at the clinical examination 2 months after installing. It was found at meat inspection that the main reasons for condemnation of carcasses of normally and emergency slaughtered pigs were parasitic injuries of the liver, abscesses and arthritis. In the "welcome-stables" the mortality rate was comparatively low, 38 percent of the total mortality. Most pigs died during the fifth week after being moved to the "finishing stable". This was probably the result of the changed environment. In this light, the extra change of environment involved by use of "welcome-stables" seems to be a negative factor but if the advantages of the entire system are considered, its effects on animal health can be judged as overwhelmingly positive. (Merryman-East Central)

## 3247 - A7, A11, B2, C2

### MANURE HANDLING AND THE CONDITIONS OF AMMONIA FORMATION IN SWINE KEEPING WITHOUT LITTER,

University of Veterinary Science, Budapest, Hungary
E. Sallai
In: Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademiai Kiado, 1975. p. 57-62. 3 fig.

Descriptors: Ammonia, Air pollution, Liquid wastes, Confinement pens.
Identifiers: Swine, Animal health.

Two experiments were performed in climatic chambers. In Experiment 1, fluctuations of ammonia concentration were determined at different temperatures as a function of time. In Experiment 2, the effect of the adjustment of liquid manure to a mildly acid pH on aerial ammonia concentration was examined. Various groups of bacteria present in the liquid manure were also examined for influence on air ammonia level, with special regard to urease-active bacteria. In Experiment I, 3 swine groups, each consisting of 4 animals weighing on average 75 kg, were placed in 3 climatic chambers in which all environmental conditions except temperature were identical. Before the experiment, stable floors were scrubbed. Air was completely exchanged and the inlet of the waste drains was closed. Air samples were taken at 0, 3, 7, 11, 16, 20, 24, 28, and 32 hours. After taking air samplings, samples were secured from the liquid manure for pH-determination and measurements of floor temperature were taken. Experiment 2 was performed on 2 groups of swine in 2 climatic chambers in which all environmental conditions were identical, but the floor of 1 chamber was strewn with 100 grams of superphosphate per square meter floor space. It was found that ammonia content of stable air is directly related to degree of floor contamination by liquid manure, population density, and moisture absorption properties of the flooring; whereas, it is inversely related to cleaning frequency and the degree of ventilation. If the floor is soiled with liquid manure, ammonia concentration will rise above the maximum tolerated level within 12 hours at the higher ambient temperatures. Liquid manure should be removed more than once daily if air exchange is poor. In stables with slatted flooring, continuous exhaustion of air from the dung passage is imperative, and if temperature rises, frequent evacuation of the dung passage is also necessary. If this is not possible, air exchange should be so controlled that it prevents the accumulation of ammonia. (Merryman-East Central)

## 3248 - A4, A5, A7, A8, A10, A11, A12, B1, C3

### LARGE-SCALE MANAGEMENT SYSTEMS AND ENVIRONMENTAL PROTECTION,

Agricultural College, Wroclaw, Poland
M. Cena
In: Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademial, Kiado, 1975. p. 63-65.

Descriptors: Pollution, Farm wastes, Waste storage.
Identifiers: Waste management, Environmental Protection, Hygiene.

All changes in the composition of soil, water, air and animal feed affect in due course man, who thus has to face not only the favorable but also the unfavorable consequences of his interference with the laws of nature. Thus the responsibility of the animal hygienist for the protection of human environment is multiple and great. His cooperation is wanted in the prevention of soil and water pollution by the wastes of large-scale animal production and he has the major share in establishing appropriate methods for the reduction of the bacterial load in liquid manure by disinfection in order to prevent the mediation of pathogenic agents to man and animals. Apart from the bacteriological, epidemiological and epizootological aspects, the disposal and handling of liquid manure present a score of other problems in respect to storage and utilization. Liquid manure may provide a haven for the eggs of many insects and pests. It also may be the source of obnoxious odors. (Merryman-East Central)

## 3249 - A7, A11, B1, C2

### THE EFFECT OF AMMONIA ON THE ORGANISM OF POULTRY UNDER EXPERIMENTAL AND FIELD CONDITIONS,

Veterinary College, Kosice, Czechoslovakia
J. Rosocha, L. Para, O. Garaj, and M. Sitko
In: Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademiai, Kiado, 1975. p. 66-68

Descriptors: Ammonia, Air pollution, Poultry, Performance.
Identifiers: Animal health, Czechoslavakia, Haematology.

The effect of various concentrations of aerial ammonia on health and production of layers and broilers was examined under Czechoslovakian laboratory and field conditions. Health state, behavior, qualitative and quantitative blood picture, haemoglobin and blood ammonia level were determined throughout the experimental period and examinations were made for gross and microscopic lesions related to excess aerial ammonia. Layers kept at 75-100 ppm ammonia concentrations developed keratoconjunctivitis, which lasted the initial 10-12 weeks and then disappeared. Birds exposed to 200±25 ppm aerial ammonia in boxes became restless and irritable. By day 2-3, the birds were apathetic, refused most of their food, drank much, and had sporadic occurrence of diarrhoea. At the end of the experiment, the birds were recumbent, lost appetite almost completely and showed cojuctivitis accompanied by lacrimation or exudation and a slight keratitis, as well as difficult respiration and exudation of the upper airways. Broilers exposed to excess ammonia consumed less food, showing weight gain decrease. Three-month exposure of layers to 40-60 ppm and 75-100 ppm ammonia resulted in a significant increase of erythrocyte count, and rise of haemoglobin level. Haematological data of the other experimental birds did not, however, differ significantly from control values. Differential blood cell counts showed a distinctive leukocytosis in birds exposed under field conditions and in those exposed in boxes to 200±25 ppm. Blood ammonia levels didn't differ significantly between experimental and control birds. Grossly, the birds exposed to 200±25 ppm showed a greyish-white cataract of the cornea, slight thickening, minor haemorrhages and hyperaemia of the mucosa of the lower lids and the upper airways. Birds exposed to lower concentrations showed similar changes for 3 months, after which degenerative changes of different degrees were found in hepatic and renal parenchyma. Microscopically, lesions of the corneal epithelium, heaemorrhages of the respiratory mucosa, epithelial desquamation, infiltration of the mucosa, submucosa and perivascular, area by lymphocytes and polymorphonuclear cells were found. (Merryman-East Central)

### 3250 - A7, A11, B2, B4, C2, D1, E3

### SOME RESULTS REGARDING LIQUID MANURE GAS POISONING,

Royal Veterinary College, Sakra Division, Sweden
O. Hogsved
In: Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademiai, Kiado, 1975. p. 69-72. 13 ref.

Descriptors: Air pollution, Hydrogen sulphide, Liquid wastes, Waste storage, Ammonia.
Identifiers: Animal health, Sweden, Poisoning.

Many poisonings of cattle and pigs have occurred in Sweden as a result of heavy agitation of long-stored liquid manure. Acute cases have also occurred when agitation has taken place in manure tanks out of doors if there was an open connection between building and tank. Hydrogen sulphide is considered as the main cause of such poisonings. In acute poisoning, there is a general propensity for haemorrhaging and extravasation. Severe lung oedema and extensive haemorrhages in muscles and visceral organs are common. In many cattle houses with liquid manure handling, a special type of chronic disease has been observed (chiefly in dairy cows). Hydrogen sulphide and or other components of liquid manure gases are believed to be responsible for this chronic disease. The symptoms may vary depending on the degree of poisoning, but include tramped teats, hoof disorders, dullness of hair, loss of weight, and propensity to haemorrhage. It is also felt that gases may cause abortions in dairy cows and sows. The main therapeutic measure for combatting chronic poisonings is to improve the climate in the stable. Proper ventilation is of special importance in those animal houses in which agitation and/or recirculation of liquid manure is used. When designing new farm buildings, indoor storage of liquid manure should be avoided. (Merryman-East Central)

### 3251 - A11, A12, B1, C3, F3

### CONSIDERATION OF THE PARASITOLOGIC AND HYGIENEIC CONSEQUENCES OF INTENSIFICATION IN ANIMAL HUSBANDRY,

Agricultural Academy, Olsztyn, Poland
St. Tarczynski
In: Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademiai, Kiado, 1975. p. 73-75

Descriptors: Parasitism, Management, Health.
Identifiers: Parasitology, Animal health, Poland.

The veterinary parasitologist is confronted with a score of new problems, which might be approached along the following lines of research: (1) Fluctuation of whole parasite populations under the conditions of intensive animal keeping, (2) Probable biological, dimensional, and structural alterations of parasite groups at extreme population densities of the host, (3) Impact of large-scale animal management systems on invasiveness of parasites, and its epizootological and hygienic consequences, with special regard to zoonoses, and (4) Development of new natural interrelationships between host and parasite, including the circulation of the latter in nature and in the man-made environment of large-scale farms. A deeper understanding of these problems is indispensable, not only for the prevention and control of parasitoses in intensively managed large groups of animals, but also for the protection of the environment of man from heavy contamination by those infective stages (cysts, eggs, larvae) which may also establish themselves in humans. (Merryman-East Central).

### 3252 - A4, A8, A11, A12, B2, E2

### HYGIENIC PROBLEMS OF LIQUID MANURE TREATMENT ON LARGE-SCALE FARMS OF THE COUNTY TOLNA,

County Public Health Station, Szekszard, Hungary
A. Kovacs
In: Progress in Animal Hygiene, F. Kovacs and P. Rafai, (ed). Budapest, Akademiai Kiado, 1975. p. 76-77.

Descriptors: Liquid wastes, Waste treatment, Public health, Irrigation, Water pollution.
Identifiers: Hungary, Animal health, Waste management, Pathogens, Land disposal.

Large-scale management of livestock units has great technical advantages, but present methods of manure-handling permanently and perhaps irreversibly pollute the environment. This can only be prevented by the collaboration of agricultural technical, animal hygienic and public health experts. Liquid manure emanating from livestock units in county Tolna, Hungary, consists of non-composted diluted fresh feces and urine containing many pathogenic microorganisms. Because the liquid manure also contains many valuable ingredients, extensive studies are being conducted on its utilization for irrigation. In one pig unit of the county Tolna, the liquid manure flows through an expensive precipitating apparatus into a storage pond. The original idea was that the irrigation pipe system should be supplied directly from the pond, but this failed because of technical defects. At present, an emergency storage pond is used nearby the unit. In another unit, the liquid manure is collected in cisterns. Originally, a liquid manure tank with filling and emptying pump was planned to transport the manure onto arable land, but it could not manage the large amounts produced. Then, composting of the manure with grass was tried, but it was soon found that this manure doesn't yield to composting. At present, the manure is conducted in open ditches and is allowed to trickle away into the deep ploughed soil. This spoils the arable land which may become unfit for agricultural production within a few years, for agrobiological reasons. In order to resolve the waste management problem so that the requirements of hygiene and agricultural utilization may both be met, county health officials suggested the separation of the liquid and solid phase of the liquid manure in earth-pits. The solid phase could be used for fertilization or composting, whereas the liquid phase could be purified in ponds by using a suitable flora. This waste management is still in the experimental phase, and only the laboratory tests will testify to its efficiency. (Merryman-East Central)

### 3253 - A7, A11, B1

### NON-MECHANICAL VENTILATION OF ANIMAL HOUSING FACILITIES,

Extension Agricultural Engineer, The Pennsylvania State University, University Park
G. R. Bodman
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, Lincoln, June 27-30, 1976, Paper No. 76-4041, 17 p. 9 fig, 1 tab, 8 ref.

Descriptors: Ventilation, Management, Design.
Identifiers: Cold housing, Non-mechanical ventilation.

Maintaining a quality environment for animals provides improved herd health, increased growth efficiency and eased management. Consequently, in planning an animal housing facility, a system must be developed which provides healthful environmental conditions within the animal space. In the case of an animal housing ventilation system, the functions are to remove moisture, excess heat, odors, and dust from the building while providing a continual supply of oxygen-rich fresh air for support of metabolic processes. With the advent of "cold" animal housing, "natural" or non-mechanical ventilation has gained interest. Variables which affect the performance of non-mechanical ventilation systems are: (1) animal heat production, (2) structural orientation, (3) ridge opening, (4) roof slope, (5) eave opening, (6) sidewall openings, (7) sidewall height, (8) insulation, and (9) miscellaneous structural details. Ventilating animal housing facilities without the use of mechanical equipment has been demonstrated to be practical and capable of providing the desired environmental conditions within the animal zone. The importance of certain structural details makes it essential that the ventilation system is considered from the beginning planning stages through to completion of the facility. (Rowe-East Central)

### 3254 - A8, B2, E2

### MODELING THE EFFECTS OF MANAGEMENT ALTERNATIVES ON THE DESIGN OF CATTLE FEEDLOT RUNOFF CONTROL FACILITIES,

Department of Agricultural Engineering, Oregon State University, Corvallis
R. B. Wensink and R. J. Miner
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, Lincoln, June 27-30, 1976, Paper No. 76-4034, 20 p. 2 fig, 10 tab, 2 ref.

Descriptors: Agricultural runoff, Design, Model studies, Feedlots, Climate, Precipitation, Effluents, Crop response.
Identifiers: Runoff control, Land disposal.

A cattle feedlot runoff control simulation model was developed which would integrate the effects of alternate dewatering policies on minimum facility volumes. The simulation model determined relationships between historical climatological data, dewatering schedules, and minimum feedlot runoff control volumes. The model was used at 7 selected locations in the United States to determine the effects of 5 pumping rates and 7 management dewatering alternatives on the minimum storage volumes required to prevent discharges as defined by EPA Effluent Guidelines. Stations were selected from each major climatic region in the United States and represented a broad spectrum of precipitation patterns. The 7 management policies were partitioned into 2 major classes. The first class permitted pond dewatering throughout the year while the second class allowed only non-winter disposals. The first management class required the minimum pond volume to satisfy the design criteria at all stations. The non-winter dewatering class simulated effluent disposal onto both corn and hay crops with variations of pre-planting and post-harvest disposals. At all stations, the corn scenario without post-harvest disposal, required the largest pond volumes. In addition to the minimum pond volume, the model also listed the average number of yearly pumpings for each simulated management alternative at a selected pumping rate. (Rowe-East Central)

### 3255 - B1, F2

### MINNESOTA REGULATIONS FOR ANIMAL WASTE CONTROL,

Extension Agricultural Engineer, University of Minnesota, St. Paul
P. R. Goodrich
Minnesota Regulations for Animal Waste Control, Special Report 41, Agricultural Engineering, Agricultural Extension Service, University of Minneosta, 1973, 12 p. 3 fig.

Descriptors: Minnesota, Regulation, Feedlots, Waste storage, Transportation, Waste disposal, Permits.
Identifiers: Waste control.

This publication presents Minnesota animal waste control regulations, which were enacted in April, 1971, in a form that feedlot operators can easily understand. The regulations govern the storage, transportation, and disposal of animal wastes and the registrations and issuing of permits for the construction and operation of animal waste disposal systems. Control measures, where deemed necessary, are to be individually designed and developed to provide the specific controls needed for the operation in question. (Rowe-East Central)

### 3256 - A6, B1, A2

### NEW PRODUCT FOR MANURE ODOR CONTROL,

Wallaces Farmer, Vol. 101, No. 15, p. 80, 1976.

Descriptors: Livestock.
Identifiers: Odor control, NONScents.

A new product, NONScents, is being introduced by Haze Products of Trenton, Missouri to control manure odor. The product can be broadcast or sprinkled directly into areas where manure odor is a problem. NONScents provides a healthier environment for livestock and increases manure value. It can be used wherever animal waste is found. (Rowe-East Central)

## 3257 - A5, A8, B1, C2

## NITROGEN IN SOIL CORES AND GROUND WATER UNDER ABANDONED CATTLE FEEDLOTS,

Soil Scientist, United States Department of Agriculture, Lincoln, Nebraska
L. N. Mielke and J. R. Ellis
Journal of Environmental Quality, Vol. 5, No. 1, p. 71-75, January-March, 1976. 5 fig, 2 tab, 17 ref.

Descriptors: Groundwater pollution, Nitrates, Sampling.
Identifiers: Abandoned feedlots, Soil cores.

Soil core samples were taken from 4 abandoned beef cattle feedlots and analyzed to determine their chemical and physical characteristics, The cores were compared with those from active upland, intermittently used feedlots and croplands. By means of continuous-flow automated analysis methods, ammonia-N and $NO_3$-N were determined on 1 M KCl soil extracts and clarified water samples. Percent soil water was determined on each sample. Soil cores were selected to characterize the percent water distribution at time of sampling and at 1/3 and 15 bars tension. The average of 7,210 kg/ha of $NO_3$-N in a 9.1 m soil core of the abandoned feedlot was higher than for any other of the comparable feedlot management practices. It was determined that an abandoned feedlot has great potential for nitrogen mineralization. Drying and cracking of the feedlot surface will open the feedlot surface to water and oxygen, and promote mineralization and leaching of $NO_3$-N into the deep profile and ground water. (Rowe-East Central)

## 3258 - A7, B1

## MODEL STUDY OF FIVE TYPES OF MANURE PIT VENTILATION SYSTEMS,

District Agricultural Engineer, Nebraska University, Nebraska Experiment Station, Concord
S. H. Pohl and M. A. Hellickson
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, Lincoln, June 27-30, 1976, Paper No. 76-4042, 37 p. 19 fig, 3 tab, 28 ref.

Descriptors: Model studies, Ventilation, Confinement pens, Design.
Identifiers: Swine, Air velocities, Air distribution, Manure pits.

A study was conducted to: (1) determine the influence of manure pit ventilation system geometry on air removal from a swine building and (2) evaluate the effects of pit ventilation system geometry on swine building ventilation characteristics. The performance of 5 types of pit ventilation systems were studied in a 1/12 size scale model swine finishing building. The systems were: (1) a slotted pipe underslat ventilator, (2) a centered duct pit ventilator, (3) an outside wall pit ventilator, (4) a hooded manure pit exhaust system, and (5) a pressurized pit ventilator. It was found that pit ventilation system design had a significant effect on average air flow velocities in the pit, but not at the swine level. Also, pit ventilation system location with respect to baffle ceiling inlet arrangement was important in developing proper ventilation design. Satisfactory air velocity distribution was achieved from the front to the back of the model for all pit ventilation systems with the exception of the outside wall pit ventilator. Relatively uniform air velocity flows were found in the model for the pressurized pit ventilator system, the centered duct pit ventilator, and the slotted pipe under-slat ventilator, when used with a center-baffled ceiling inlet. The fastest evacuation times were recorded using the pressurized pit ventilator system and the hooded manure pit exhaust system. The pressurized pit ventilator system had the best overall ventilation performance, with the centered duct pit ventilator also providing adequate ventilation characteristics. Poor ventilation characteristics were noted for the slotted pipe under-slat ventilator. (Rowe-East Central)

## 3259 - A3, B1, C2, E2

## NITROGEN AND PHOSPHORUS LOSSES FROM WINTER DISPOSAL OF DAIRY MANURE,

Research Associate, Department of Agronomy, Cornell University, Ithaca
S. D. Klausner, P. J. Zwerman, and D. F. Ellis
Journal of Environmental Quality, Vol. 5, No. 1, p. 47-49, January-March, 1976. 3 tab, 2 fig, 16 ref.

Descriptors: Agricultural runoff, Watersheds, Nitrogen, Phosphorus.
Identifiers: Land disposal, Dairy manure, Nutrient losses.

An evaluation was made of surface runoff losses of inorganic nitrogen and total soluble phosphorus from fields receiving winter applications of dairy manure. Runoff losses, as derived from natural precipitation, were accumulated for the time period January 1 to March 31 for 3 consecutive years, (1972-1974). The manure treatments for a continuous corn cropping system were 35, 100, and 200 wet metric tons/ha. The 100 and 200 metric ton/ha rates were replicated twice, the 35 metric ton /ha was replicated 4 times for a total of 8 experimental plots per year. After each runoff event, a 250-ml subsample of the runoff was utilized for analysis. Runoff samples of 250-ml were centrifuged at 37,000 RCT (relative centrifugal force) for 30 minutes. The supernatant was analyzed for $NH_4$-N, $NO_3$-N, inorganic-P, and total soluble P. Adverse weather conditions during and after the winter disposal in 1972 caused increased nutrient discharges in runoff. This was especially evident at the 100 metric tons/ha rate which was applied on top of melting snow. The data clearly indicated that manure disposal during active thaw periods can result in excessive nutrient losses, while nutrient losses were minimized when manure was applied and then covered with snow, melting at a later date. The 35 metric tons/ha application rate, applied on frozen soil and then covered with snow before a thaw period, resulted in the lowest nutrient losses when compared to areas that received no manure at all. (Rowe-East Central)

## 3260 - A8, B1, C1, C2, E2

## MIGRATION OF SALT FROM FEEDLOT WASTE AS AFFECTED BY MOISURE REGIME AND AGGREGATE SIZE,

Graduate Assistant, Department of Soils, Water and Engineering, Arizona University, Tucson
A. Amoozegar-Fard, W. H. Fuller, and A. W. Warrick
Journal of Environmental Quality, Vol. 4, No. 4, p. 468-472, October-December, 1975. 2 fig, 6 tab, 14 ref.

Descriptors: Salts, Nutrients, Saturation.
Identifiers: Land application, Feedlot wastes, Moisture regime, Aggregate size.

Migration of salt from 3 different aggregate sizes of feedlot manure under 3 moisture regimes was studied. The 3 sizes were small (to pass through a 40-mesh sieve), medium (0.9 cm in diameter, 2.25 cm in length), and large (4.8 cm in diameter, 2.6 cm in length). The 3 moisture regimes were: (1) 12 hours saturation, 12 hours drainage by gravity, repeated with 5 saturation cycles, (2) 12 hours saturation, 12 hours drainage by gravity, and 48 hours oven drying at 60 degrees C, also repeated with 5 cycles, and (3) continuous leaching for 60 hours at a constant rate. The experiment was assigned a completely randomized design with factorial combinations and 4 replicates for each treatment. After each 12 hour saturation, the leachates were collected and the electrical conductivity, pH, and concentrations of K, Na, Ca, Ma, $NH_4$, $NO_3$, Cl, S, P, and 8 trace elements were determined. The results indicated that the hazardous salts, K and Na, present in the manure were highly soluble and could be leached out readily. However, the divalent cations, Ca and Mg; and the nutrient materials, N and P; and trace elements were less soluble and migrated more slowly. The results also indicated that the larger the aggregate, the less of a chance for fast removal of salts under any water treatment. For best land application results, medium size aggregates of manure are probably best. They will provide a more uniform distribution and also a better salt management program than large-sized aggregates. It was found that intermittent irrigation is preferable to continuous leaching for salt management purposes. The total loss of nutrients under continuous leaching was greater than the total loss under intermittent saturation, although the loss in K, Na, Ca, and Mg was less severe. (Rowe-East Central)

## 3261 - A11, B1, F6

## A NOTE ON THE RECOVERY OF POLYETHYLENE PARTICLES FROM FAECES AND RUMEN CONTENTS OF STEERS,

School of Agriculture, 581 King Street, Aberdeen, Scotland
J. Fordyce and M. Kay
Animal Production, Vol. 18, No. 1, p. 101-104, 1974.

Descriptors: Feeds.
Identifiers: Polyethylene particles, Roughage, Retention time.

Two experiments were conducted with 3 types of polyethylene particles to determine their retention time in castrated male cattle offered diets which contained predominantly cereals ad libitum. Three types of polyethylene particles were used: (1) corrugated particles, of length 1.27 cm, breadth 0.95 cm, depth 0.63 cm and specific gravity 0.92 (RT), (2) rods, of length 1.27 cm, diameter 0.32 cm and specific gravity 0.94 (BP), and (3) particles having the same dimensions and specific gravity as RT, but being circular in cross-section, without the corrugated edges of RT (RBP). In all the steers used in the experiments, polyethylene passed through the alimentary tract to be lost in the feces. The loss was most rapid in the heaviest of the steers. The short retention time of the plastic in these steers suggests that it does not remain in the rumen long enough to act as an effective substitute for roughage. Since polyethylene also passed through the alimentary tract of steers weighing 170 and 250 kg live weight at an appreciable rate, it may be necessary to repeat doses of the polyethylene particles at frequent intervals. (Rowe-East Central)

## 3262 - A2, A6, B2, B3, B4, E2

## MANAGING FEEDLOTS FOR ODOR CONTROL,

Agricultural Engineer, Texas Agricultural Extension Service, Texas A&M University System, College Station
J. M. Sweeten and D. L. Reddell
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, June 27-30, 1976, Paper No. 76-4016, 24 p. 4 fig, 2 tab, 30 ref.

Descriptors: Feedlots, Agricultural runoff, Liquid wastes, Solid wastes.
Identifiers: Odor control, Location, Odor measurement, Manure pack, Stockpiling, Land disposal, Chemical control, Settling basins, Retention ponds.

While location is considered the key to feedlot odor abatement, there are specific odor alleviating techniques that may be employed by feedlots that are not well located and that have odor problems. Economically feasible odor control practices include the following: (1) Maintain excellent surface drainage at uniform feedpen slopes of 1 percent (for dry areas) to 4 percent (for moderately humid areas). (2) Collect only loose surface (aerobic manure) at frequent intervals. (3) Use elevating scrapers or road graders for collection. (4) Maintain a compacted (anaerobic manure pack on the feedlot surface at all times. (5) Dispose of dead animals within 48 hours. (6) Dewater feedlot runoff retention ponds as quickly as possible. (7) Separate manure solids from feedlot runoff by maintaining ideal pen slopes and constructing settling basins on channels. Temporary odor control may be achieved by the use of chemicals in the form of masking agents, counteractants, chemical deodorants, or digestive odorants. (Merryman-East Central)

### 3263 - A6, A10, B2, B4, C2, E2
### MANAGING DAIRY WASTE HOLDING PONDS IN THE CENTRAL VALLEY,

Farm Advisor, Stanislaus County, California
E. H. Olson, G. A. Hutton, Jr., and J. L. Meyer
Leaflet 2326, Division of Agricultural Sciences, University of California, August, 1975, 5 p. 3 fig, 1 tab.

Descriptors: Waste storage, Irrigation, Nutrients, Odor, Insects, Legal aspects.
Identifiers: Holding ponds, Land disposal, Animal health.

Waste holding ponds are efficient and economical for collecting, temporarily storing, and diluting animal waste for use in basin or flood irrigation systems. However, proper management of waste holding ponds is necessary for conserving nutrients, controlling odors and insect vectors, meeting legal requirements, and improving animal health. Tips for good management are: (1) Empty the entire pond, including all sludge, at every possible irrigation to save nutrients. (2) During hot summer months, empty the pond completely at least once a month. Empty the pond during the last irrigation of the season to ready it for winter storage. (3) Whenever the pond is emptied, add about 1 foot of fresh water to prevent odors. (4) Install liquid-solid separators when floating solids are a problem. Such solids can clog small irrigation valves or siphon tubes, encourage vectors and cause odors. (Merryman-East Central)

### 3264 - A8, B1, D3, E2, E3
### METHANE FARMING IN KENYA

Tunnel Estate, Fort Ternan, Kenya
T. H. Hutchinson
Compost Science, Vol. 13, No. 6, p. 30-31, November/December, 1972.

Descriptors: Recycling, Methane, Sludge, Crop response.
Identifiers: Kenya, Land disposal, Coffee, Compost.

The methane plants discussed in this article were designed to operate from (a) grass, straw, coffee pulp and other organic material mixed with manure and (b) manure mixed with water to make it into a liquid sludge. The difference between them is that type (a) consists of a series of compartments which are filled and emptied in rotation, and which produces compost and liquid manure and type (b) is one large compartment that is topped up daily with fresh manure. This displaces an equal quantity of digested sludge, and so the fermentation is continuous. Since 1955, 150 tons of compost and 18,000 gallons of liquid manure have been produced from the type (a) plant, and since 1957, approximately 90,000 gallons of sludge has been produced each year from type (b) plant. The compost and sludge was applied to 3 different blocks during different time periods. Block 1 (12.5 acres) was first planted in 1925. Block 2 (14 acres) was first planted in 1932. Block 3 (24 acres) was first planted in 1937. For 7 years prior to the building of the first methane plant (1948-1954) the average coffee yield for these blocks was 2.56 cwt. clean coffee per acre, and for the 7 years after commencing to use the residue from the plants the average yield rose to 5.93 cwt. It may also be noted that the fertility appears to be rising progressively. The figure for the last 3 seasons (1959-1961) has risen to 6.95 cwt. The gas produced by the plants is used in the house for cooking, water heating through a geyser, and a converted paraffin refrigerator. The gas has also been found to be an excellent fuel for stationary engines and production of electricity. (Rowe-East Central)

### 3265 - A5, B1, C2
### INFILTRATION OF WATER ON A CATTLE FEEDLOT,

Soil Scientist, Agricultural Research Service, U.S. Department of Agriculture
L. N. Mielke and A. P. Mazurak
Transactions of the ASAE, Vol. 19, No. 2, p. 341-344, March-April, 1976. 3 fig, 4 tab, 15 ref.

Descriptors: Feedlots, Infiltration rates, Groundwater pollution, Hydraulic conductivity, Porosity, Bulk density.
Identifiers: Manure pack, Air permeability.

Four undisturbed soil cores from an active cattle feedlot, encased in heat-shrink plastic, were used in the laboratory to measure infiltration. Six additional undisturbed feedlot soil cores and 2 cores from adjacent cropland were taken for measurements of air permeability, hydraulic conductivity, porosity, particle-size distribution, bulk density, and organic matter content. Early field observations of outdoor cattle feedlots showed that a dense layer exists near the soil surface that apparently decreases water intake. Research results showed a low $NO_3$-N content in the groundwater (1-2 m depth) in the immediate vicinity of the feedlot in contrast with much higher $NO_3$-N content in wells under cropland. Water intake in the feedlot and into undisturbed complete feedlot soil cores was extremely slow (range from $0.38 \times 10^{-2}$ to $2.3 \times 10^{2}$ cm/day. Air and water permeabilities were lowest in the interface section and increased in the soil below. Water permeability increased 28-fold between the interface layer and the next layer 10 cm deeper. Bulk density was 1.68 g/cm$^3$ in the mineral soil in the interface layer. Interface soil showed maximum compaction of 1.70 g/cm$^3$ at 18 percent water content. No water moved through the interface material during 6 days. Undisturbed feedlot soil cores and feedlot interface material compacted at water content for maximum density were found to be effective barriers to water movement, an important fact in understanding feedlot hydrology and protecting groundwater quality. (Rowe-East Central)

### 3266 - A8, B2, C2, E2
### KEARNEY FEEDER'S EARLY EFFORT EARNS ENVIRONMENTAL AWARD,

Anonymous
Nebraska Farmer, Vol. 118, No. 14, p. 18, July 17, 1976. 2 fig.

Descriptors: Management, Feedlots, Design.
Identifiers: Awards, Holding ponds, Land disposal.

Lewis Feedlot, Inc. won the third annual J. L. Higgins Award for outstanding efforts in controlling livestock waste. Between $150,000 and $200,000 was spent on construction of the 4 waste control systems in use on his 160-acre feedlot. The feedlot is located on flat valley land adjacent to the Wood River northeast of Kearney which, Lewis said, complicated the waste disposal problem. It meant that all the rainfall that falls on that lot had to be controlled so it wouldn't flow into the river. The difficulty was overcome by building mounds at the center of each pen in the feedlot and sloping the land away from the feed bunks toward the other side of the lot, where the drainage ditches channel wastes into holding ponds. Several wire-screened debris traps made of hardware cloth were located in the drainage ditches to separate solid from liquid wastes and slow the liquids. From the holding pond, an electrical pump is used to pump the liquid wastes through gated pipeline so it can be distributed down rows on cropland whenever the pond requires emptying. Solid wastes are spread on the cropland as fertilizer. The Lewis farm unit includes about 1,200 acres of irrigated land and 600 acres of dryland. Corn lot silage is the main crop. (Rowe-East Central)

### 3267 - A8, B2, C2, E2
### LAND DISPOSAL OF SWINE MANURE,

Texas Agricultural Extension Service, The Texas A&M University System, College Station
J. M. Sweeten and C. D. Welch
Publication MP-1269, Texas Agricultural Extension Service, Texas A&M University, March, 1976, 8 p. 3 fig, 5 tab.

Descriptors: Anaerobic lagoons, Effluents, Nutrients, Fertilizers.
Identifiers: Land disposal, Swine manure, Storage pits.

Information is given concerning the nutrient content, the effects on soils, and the application rates of swine manure and anaerobic lagoon effluent. It was determined that: (1) Liquid swine manure from underfloor storage pits can be safely applied to most Texas soils at the rate of 5000 gal/acre/year. (2) Effluent from anaerobic lagoons serving swine confinement units can be safely applied to most soils in Texas at the rate of 20,000 gal/acre/year without causing nitrogen accumulations in the soil, provided that high nitrogen requiring crops are grown. (3) At these rates, the amount of land recommended for terminal disposal of liquid swine manure without lagoon treatment is 1 acre/sow (farrowing unit capacity) for total confinement farrow-to-finish operations, or 9 acres per 100-market-hor capacity for finishing operations. (4) Lagoon treatment of swine wastes results in an appreciable loss of the fertilizer value of manure, but also reduces the land area requirements for disposal. (Rowe-East Central)

### 3268 - A11
### ISOLATION OF INFECTIOUS BOVINE RHINOTRACHEITIS VIRUS FROM FECES OF A FEEDER STEER,

Laboratories of Veterinary Diagnostic Medicine, University of Illinois, Urbana
R. A. Crandell
American Journal of Veterinary Research, Vol. 35, No. 7, p. 951-952, July, 1974. 1 tab, 13 ref.

Descriptors: Viruses, Animal health.
Identifiers: Feces.

A study was conducted to describe the isolation of infectious bovine rhinotracheitis (IBR) virus from a rectal swab. Isolation was made from a feeder steer during a feedlot epizootic of IBR involving 246 nonvaccinated steers. Thirty percent of the steers had mucopurulent ocular discharge; 1 percent had mucopurulent nasal discharge; and many steers were coughing. Viral specimens were grown in cultures containing 2 times normal concentration of antibiotics and stored at -7[illegible] degrees C until tested. Madin-Darby bovine kidney cells were grown in culture mediums containing 200 units of penicillin, 200 μg of streptomycin, and 2.5 μg of amphotericin B per milliliter. The kidney cell cultures were inoculated with 0.1 and 0.2 ml of the supernatant of each specimen. The cells were incubated at 36 degrees C and observed each day for cytopathic effect. Serum-ne Serum-neutralizationhtests were conducted by mixing 200-800 median tissue culture infective doses of each of the isolates with an equal volume of twofold dilutions of known IBR-immune serum, incubating for 30 minutes at 37 degrees C, and inoculating each of 3 MDBK tubes with 0.2 ml of each serum-virus mixture. The MDBK cell cultures inoculated with the conjunctival and nasal swabs from steer 2 and the conjunctival swabs from steer 4 had cytopathic effect (CPE) characteristics of IBR virus 48-72 hours after inoculation. The CPE in the cultures inoculated with rectal swab from steer 4 was observed 96 hours after inoculation. Results of examinations of all other specimens were negative for virus. Study results indicated that virus was active in the herd several weeks before the clinical illness was recognized and that the infection was limited to the upper respiratory tract. (Rowe-East Central)

### 3269 - A6, B2, C2, D3
### MANAGEMENT OF LAGOONS FOR ODOR CONTROL,

Department of Biological and Agricultural Engineering, North Carolina State University, Raleigh
M. R. Overcash, F. J. Humenik and P. W. Westerman
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, Lincoln, June 27-30, 1976, Paper No. 76-2017, 18 p. 5 fig, 6 tab, 13 ref.

Descriptors: Lagoons, Management, Aeration, Nitrogen, Dissolved oxygen, Chemical oxygen demand.
Identifiers: Odor control.

The response of unaerated lagoons to different loading intensities and variable aeration was studied. Particular attention was given to constituent removals and odor potential. Liquid samples from field pilot-scale lagoons were taken at mid-depth. Samples were refrigerated at approximately 4 degrees C until analyzed. All tests were run in accordance with procedures outlined in Standard Methods (1971) and demonstrated animal waste adaptations (Overcash, 1975). Based upon periodic field observation and odor panel rankings, it was determined that there was a discernible odor threshold for unaerated swine waste lagoons loaded at approximately 9.2-18.4 $m^3$/45-kg hog. Individual consensus indicated that the frequency or probability of odor detection, when visiting the unaerated lagoon site, was 80 percent for the unit at 0.6 $m^3$/45-kg hog; 60 percent for 2.3 $m^3$ 45-kg hog; 20 percent for 4.6 $m^3$/45-kg hog; and little odor for units with 9.2 $m^3$/45-kg hog. No dissolved oxygen was found at depths greater than 10 cm. Supernatant organic and nitrogen concentrations for surface aerated units without bulk phase dissolved oxygen was found in aerated units. Reduced odor potential existed for surface aerated units at the same loading intensity in comparison to similar unaerated reactors. Supernatant COD and TOC concentrations increased with increased aeration rates from 37-120 watts and associated greater bottom scour, while TKN concentrations only modestly increased, indicating that the greatest impact of surface aeration was on nitrogen reduction by ammonia volatilization. (Rowe-East Central)

### 3270 - A2, A8, B2, C2, E2
### IRRIGATION WITH FEEDLOT RUNOFF,

Animal Waste Management Research Unit, North Central Region, Agricultural Research Service, U. S. Department of Agriculture
C. L. Linderman and L. N. Mielke
In: Proceedings, Nebraska Irrigation Short Course, Agricultural Engineering, "Irrigation" No. 9, Lincoln, Nebraska, January 20-21, 1975, p. 26-37, 2 fig, 4 tab, 7 ref.

Descriptors: Irrigation, Feedlots, Agricultural runoff, Crop response, Nitrates, Salts, Sampling.

A plan for feedlot runoff disposal should consider: (1) the volume of runoff, (2) the cropland area available for disposal, (3) soil types and problems, (4) crop grown, (5) irrigation method, (6) existing usable irrigation systems or equipment, and (7) the time available for effluent disposal. Feedlot runoff may be either surface or sprinkler irrigated onto cropland. When furrow irrigation is used, the furrow should be left in place after harvest, since it is usually desirable to dispose of runoff in fall and early spring. Sprinkler irrigation has the disadvantage of depositing effluent solids on the crop foliage, a fact of particular importance if the whole plant is to be harvested. Sprinkler irrigation also increases the odor problem. Research in eastern Nebraska has shown the effect of frequent feedlot runoff applications on growth and yield of corn, perennial forages, and forage sorghum. Runoff was collected in a holding pond and applied weekly to small plots during the irrigation season. Application was made by furrows to corn and forage sorghum and by surface flooding on perennial forages. Corn and forage sorghum received the most benefit from feedlot effluent when about 10 to 15 inches were applied per year. Anyone planning a disposal system to apply effluent in amounts greater than about 5 inches per year should consider the solids, nutrients, and salt content of the effluent used. Effluent sampling should be done close to application time because the effluent may change greatly with time in storage. A soil sampling program should also be conducted. Where salt is force-fed in the feedlot, particular attention should be given to the salt content of the effluent and the soil. When large amounts of nitrogen are applied, followed by stress on plants, the nitrate content of the forage should be checked. (Rowe-East Central)

### 3271 - A8, B1,
### SOME SOIL STRENGTH PROPERTIES INFLUENCED BY LIVESTOCK WASTE,

Agricultural Engineering Department, South Dakota State University, Brookings
C. E. Johnson, R. J. Devine, M. E. Bjerke, and C. A. Onstad
Presented at 1974 Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, Paper No. 74-1014, 10 p. 8 fig, 10 ref.

Descriptors: Crop response, Moisture content, Bulk density, Adhesion.
Identifiers: Land disposal, Soil properties, Penetration resistance, Soil-metal friction angle, Apparent cohesion.

Total livestock wastes produced in the United States are almost two billion tons a year. Utilization and disposition of these wastes are a critical concern of the public. Disposal of livestock wastes on cropland for decomposition and mineralization has been concluded to be the most efficient method. Because of this, questions have been raised as to how much livestock wastes can be applied to cropland areas without causing harmful effects to crop production and to the soil. Cattle manure was applied to 12 experimental field plots of Egan-Wentworth silty clay loam soil in the fall of 1971, 1972, and 1973, after the soil was frozen. Application rates of 0, 55.8, 83.7, and 111.7 wet tons per acre were used in the fall of 1971. During the fall of 1972 and 1973, the application rates were almost tripled. All plots were plowed, disked, and planted to corn in the spring following the fall application of cattle manure. Moisture content, bulk density, and soil characteristics were measured during the experimental period. Experimental data revealed that (1) there was no significant difference due to application rate in the forces required to till the soil, (2) moisture content increased when application rates were above 120 wet tons per acre, and (3) soil-metal friction angle decreased. (Edwards-East Central)

### 3272 - A6, A7, B1, B4, C2
### THE EFFECT OF RATION FORMULATION ON THE SUBSEQUENT GENERATION OF VOLATILE GASES AND ODORS FROM BOVINE WASTE,

R. O. Kellems
PhD Thesis, Oregon State University, June, 1976, 59 p. 5 fig, 15 tab, 81 ref.

Descriptors: Odor, Gases, Rations, Waste storage, Hydrogen sulfide, Ammonia, Amines, Moisture content.
Identifiers: Cattle wastes.

This study was conducted to determine the effect that ration formulation has on volatilization of gases and offensiveness of the odor associated with the wastes from Holstein replacement heifers. The relationships between different variables on the release of hydrogen sulfide, ammonia, total nitrogenous gases and amines were studied in 6 separate experiments. Experimental results were: (1) As the cereal grain level of supplementation was increased from 50 to 75 percent of the diet, the rate of hydrogen sulfide evolution also increased. (2) After studying the urine and feces obtained from animals maintained on the various grains and levels of 25, 50, and 75 percent, the pH indicated a difference between grain sources. Milo caused the lowest pH and barley caused the highest,, (3) When urine was stored, the rate of volatilization was highest during the first 5 days and then the rate declined. However, when feces only were stored, the rate increased as the storage period increased. This showed that urea is rapidly hydrolyzed to form annomia under anaerobic storage conditions, (4) About 0.11 percent of the volatile basic nitrogenous gases initially volatilized from the waste was found to be amines. (5) A positive correlation was found to exist between the ammonia release and the amine evolution rate. (6) The moisture content of the waste samples were negatively correlated with the volatilization of the nitrogenous gases. (Edwards—East East Central)

### 3273 - A6, B3, C2, D1, E3
### MAKE A PROFIT ON MANURE,

American Farmer, Vol. 47, p. 30, January, 1972.

Descriptors: Fertilizers, Recycling, Feedlots, Dehydration, Odor, Economics.
Identifiers: Cattle manure.

The Thomason Ranch feedlot near Fayetteville, North Carolina, has begun to capitalize on manure. A dehydration operation was started about 8 years ago and the ranch now makes a profit out of manure by dehydrating, bagging, and selling it for the garden trade. Thomason Ranch buys manure for a small fee from a number of dairy farms in Cumberland County and processes it along with what comes from their feedlot. Since manure mixed with dirt wears out grinding equipment, only manure from dairy cows on concrete is used. A payloader tractor scoops up the manure and dumps it into big bins where it is mixed with pine bark to absorb much of the moisture. A big revolving drum drier is used to dehydrate the manure. The manure is then sterilized to kill weed seeds. A hammermill is then used to grind the manure into uniform consistency. It is then bagged in 50 or 100 lb bags for the gardeners. Chicken manure was experimented with, but the feathers mixed in with the manure caught on fire in the drier. The manure mixture, as sold, has been analyzed as 1-1-1. Problems encountered by this ranch have been: (1) a tornado which did widespread damage, (2) continued equipment investment, (3) fire hazard of stored manure, (4) seasonal nature of fertilizer sales requires a high inventory, and (5) complaints from the city of Fayetteville about feedlot odor when the wind is from the east. (Edwards-East Central)

### 3274 - A4, A6, A8, C1, C2, C3, E2, E3
### UTILIZATION OF ANIMAL MANURES AND SEWAGE SLUDGES IN FOOD AND FIBER PRODUCTION

Council for Agricultural Science and Technology
Report No. 41, Council for Agricultural Science and Technology, Iowa State University, February, 1975, 27 p.

Descriptors: Recycling, Animal wastes, Sewage sludge, Feeds, Fertilizers, Soil amendments, Economics, Salts, Heavy metals, Water pollution, Management, Land reclamation, Public heath, Crop response, Odor.
Identifiers: Land disposal.

Proper use of animal manure and sewage sludges as fertilizers, soil additives, and animal feed could improve water and air quality and save fuel and feeds resources. Application to agricultural and forest lands is influenced by physical, chemical, microbiological, sociological, economic, political, and legal factors. Limitations to use as fertilizers are bulk, low quality, variable composition, inefficiency of application and expense of transportation. They may require drying, are difficult to store, and may contain large quantities of soluble salts (especially nitrates), heavy metals, pathogenic microorganisms, odors, etc. Fear of disease has hindered use of animal manure in animal feeds. Decreasing salts, trace metals, and bacteria accompanied by quality control would make these waste products more competitive with chemical fertilizers. Conservation of the ammonia produced and development of storage systems would be beneficial. Guidelines for use which are based on facts and acceptable risks which can be interpreted in terms of local and regional conditions are needed to protect public health and environmental quality. Educational, research, and demonstration projects would improve management of sewage sludges and animal manures and would convince the population that their use can be beneficial. (Buchanan; Davidson-Wisconsin)

## 3275 - A1, B1, C2, F2

### MODELING THE ENVIORONMENTAL AND ECONOMIC EFFECTS OF DAIRY WASTE MANAGEMENT

Agricultural Waste and Watershed Research Engineer, Stittsville, Ontario, Canada
D. R. Coote, D. A. Haith, P. J. Zwerman
Transactions of the ASAE, Vol 19, No. 2, p. 326-331, March-April, 1976. 3 fig, 2 tab, 35 ref.

Descriptors: Model studies, Dairy industry, Economics, Management, Nitrogen, Phosphorus, Regulation.
Identifiers: Farm income, Soil losses.

Study objectives were: (a) to develop a mathematical model of sufficient general applicability to permit its use in analyzing a variety of environmental problems for the New York dairy farm, (b) to utilize the model to provide quantitative estimates of farm income and soil, nitrogen, and phosphorus losses associated with different cropping, manure handling and fertilizer-practices and herd sizes, and (c) to apply the model to selected dairy regions in New York to determine whether nutrient management policies which maximize farm income result in significant losses of soil, nitrogen and phosphorus to the environment. Average dairy farms were modelled in Western Jefferson and southwest Oneida counties. The Jefferson County region has poor soils and flat slopes; whereas, the Oneida location has highly productive soils and relatively steeper slopes. Results showed that, while a dairy farm model provides less than exact estimates of economic and environmental impacts, it can provide useful insights which the agricultural engineer or scientist can use to supplement both his experience and field experiments. The degree of conformity with environmental objectives is likely to be more a function of the farmer's land and soil resources than his management practices. It is felt that attempts to regulate the dairy farm to achieve protection of the environment will be successful only if regulations are sensitive to the natural resources limitations within which each farmer must operate. Waste management and cropping, fertilization and soil conservation decisions are best made on a case by case basis, recognizing the unique land resources of each farm. (Rowe-East Central)

## 3276 - A8, C2,E2

### LONG-TERM NITROGEN RATES AND SOURCES INFLUENCE SUGARBEET YIELD AND QUALITY,

Soil Scientist, ARS-USDA
A. D. Halvorson and G. P. Hartman
Agronomy Journal, Vol. 67, No. 3, p. 389-393, May-June, 1975. 3 fig, 3 tab, 22 ref.

Descriptors: Crop response, Organic wastes, Fertilizers, Nitrogen, Sugar beets.
Identifiers: Land applications, Sucrose, Crop rotation.

This study was made to evaluate the longtime residual effects of applying various rates and combinations of organic and inorganic N-fertilizer sources on sugarbeet yields, sucrose content, apparent sucrose purity, and other factors related to maximum production. The experiment was conducted at Disney, Montana, on a nearly level, irrigated Savage silty clay soil having an organic matter content of 2.99 percent. The 11.6 x 24.6 m plots were arranged in a completely randomized design with 3 replications. The experiment consisted of 14 treatments, 8 of which were sugarbeets followed by barley, until 1963; thereafter, barley was replaced by Spring wheat. Highest gross sucrose yield for the inorganic N treatments was obtained with the application of 112 kg N/ha. Application of more than 168 kg/ha of inorganic N resulted in sucrose yields that were not significantly greater than the check. Application of 22.4 metric tons/ha barnyard manure resulted in a significant yield increase when compared with the check (O-N) treatment, and the highest gross sucrose yield for all treatments in this study. Adding 67.2 metric tons/ha of barnyard manure, with or without supplemental inorganic N, reduced gross sucrose yield when compared with the 22.4 metric tons/ha manure treatment. Application of inorganic and organic N resulted in increase production of dry matter in the beet tops and reduced the root/top ratio, with the exception of 22.4 metric tons/ha barnyard manure treatment, which had a dry matter root/top ratio as high as the check. The data indicated that barnyard manure can be utilized to produce quality sugarbeets and at the same time dispose of a waste and potential pollution product. (Rowe-East Central)

## 3277 - A3, A8, B2, C1, C2, D3, E2

### SOIL-PLANT RUNOFF CHARACTERISTICS FROM LAGOON EFFLUENT DISPOSAL AREAS,

Department of Agricultural Engineering, Virginia Polytechnic Institute and State University, Blacksburg
E. R. Collins, Jr., E. T. Kornegay, and D. C. Martens
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 15-18, 1975, Paper No. 75-2559, 11 p. 7 fig, 3 ref.

Descriptors: Lagoons, Anaerobic conditions, Aerobic conditions, Biological treatment, Virginia, Soil contamination, Agricultural runoff, Nutrients, Chemical properties, Physical properties, Biological properties.
Identifiers: Swine.

Two separate concrete treatment tanks were constructed at the Virginia Polytechnic Institute and State University. They were designed so that they could be operated as a two-stage lagoon system or could be maintained as separate systems. Pits were connected to the separate tanks. One unit is being operated as an anaerobic system based on design volumes required by USDA Soil Conservation Service Virginia Standards. The other unit is equipped with a 3-housepower floating aerator operated on a percentage timer to provide aeration at a rate equivalent to twice its estimated daily $BOD_5$. Each treatment tank contains a small submersible pump for recycling effluent from the tank to flush its companion waste collection pit. Pits are flushed 5 times daily. A permanent waste irrigation system has been installed to distribute treatment tank effluent on soil-plant disposal plots. Sampling of all stages of each system is being done in order to obtain data to support meaningful conclusions. The experiment is still in progress, but study objectives are: (1) to compare 2 systems of biological treatment for swine wastes in Virginia, (2) to monitor wastes from the 2 confinement swine production facilities and effluent from their companion waste treatment systems to determine the degree of biological treatment afforded and fate of mineral feed constituents, and (3) to measure the effects of application of the lagoon effluent from the 2 systems on runoff water quality and pollutant accumulation in soil-plant disposal areas. (Edwards-East Central)

## 3278 - B2, C2, D3, E3, F1

### METHANE RECOVERY FROM ANAEROBIC LAGOONS,

Associate Professor, University of Florida
R. A. Nordstedt, J. P. Bowden, A. B. Bottcher, and J. Kutt
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, Lincoln, June 27-30, 1976, Paper No. 76-4029, 19 p. 4 fig, 9 tab, 9 ref.

Descriptors: Methane, Recycling, Anaerobic lagoons, Economics, Corrosion.
Identifiers: Gas collection, Floating covers.

Methane gas, which is a component of biogas produced in the anaerobic decomposition of organic material, is being studied as a substitute for electrical and fossil fuel energy. This study was done with the following objectives in mind: (1) to demonstrate the construction and use of floating covers to collect gas from anaerobic lagoons, (2) to characterize the gas with regard to composition, corrosiveness, and potential for use on the farm, (3) to evaluate materials and equipment used in the system, and (4) to determine the economic feasibility of methane collection from anaerobic lagoons, storage requirements and potential for use in animal production units. Three floating biogas collectors were constructed with different size, type of membrane and method of gas removal. The membrane used in collector A only weighed 0.16 kg per sq m. It was chosen due to its: (1) excellent resistance to outdoor exposure, (2) relatively high tear strength, (3) low cost, and (4) low weight. The membrane used for Collectors B and C was 0.61 kg per sq m polyvinylchloride coated 10 x 10 1,000 denier polyester scrim fabric which was reported by the manufacturer to be resistant to acids, alkalies, salts, fungi and livestock waste and soil microorganisms. Problems did develop during the experiment, ie. Collector A quickly developed leaks due to punctures in the membrane and the polyethylene and polyvinyl chloride pipe membrane supports in collectors A and B softened and collapsed. However, such problems can be recitified. Overall, the experiment was considered successful; however, the system was not in operation long enough to identify any corrosion problems which may arise in the compressor storage tanks or in equipment utilizing the gas. (Edwards-East Central)

## 3279 - A2, A4, B1, B2, F1, F2

### ECONOMIC EFFECTS OF SURFACE WATER RUNOFF CONTROLS ON MICHIGAN BEEF FEEDLOTS,

Agricultural Economist, Economic Research Service, U.S. Department of Agriculture.
J. B. Johnson and G. A. Davis
Michigan Farm Economics, No. 374, Department of Agricultural Economics, Michigan State University, March, 1974, 4 p. 4 tab.

Descriptors: Agricultural runoff, Legal aspects, Feedlots, Michigan, Management, Economics.
Identifiers: Point sources, Housing, Permits.

On or before July 1, 1977, effluent guidelines for all categories of point source dischargers will require the application of the best practicable control technology available. This study assesses the economic effects of implementing these guidelines on the Michigan beef feeding industry. Four primary types of housing are currently used in Michigan feedlots. Most prevalent is the dry-lot unpaved housing system which combines a shelter and an exposed area. Total confinement and open-lot systems are not prevalent in Michigan. The total confinement systems consist of either a cold-covered shelter enclosed on 3 sides with the fourth side fenced, or a warm-enclosed shelter with all sides enclosed. The open-lot systems have no roofed shelter. In Michigan, most open-lot systems consist of a fenced lot with a fenceline bunk and an adjoining surfaced apron. Generally, runoff and process waste water control problems are greatest for those systems with more exposed area per animal if other conditions (location and rainfall) are similar. In Michigan, the open-lot systems provide the largest square footage per animal. Followed closely by dry-lot unpaved housing systems. Capital outlays for diversion terraces and size of settling basin depend on the size of the exposed feedlot area. In Michigan, there are only a few beef feeding operations exceeding 1,000 head capacity which will be subject to announced EPA effluent guidelines and permit program. (Rowe-East Central)

## 3280 - A9, A10, A11, B1, D1, D2, F6

### DON'T SLACKEN FEEDLOT FLY CONTROL,

Nebraska Farmer, Vol. 118, No. 13, p. 59, July 3, 1976.

Descriptors: Insecticides, Performance, Feedlots.
Identifiers: Fly control, Sanitation, Feed additives, Rabon, Wasps.

Jerry De Witt, an Iowa State University Extension entomologist, says that a regular sanitation program throughout the summer is the key to effective control of feedlot flies. Houseflies and stable flies prefer to breed in the type of manure and organic matter found in and around feedlots. Houseflies are a nuisance because they spread bacteria and pathogens. Stable flies have been shown to reduce weight gains of beef animals due to the irritation that their bite produces. Both stable and house flies multiply rapidly until their populations peak in August. A sanitation program involving regular removal of potential fly breeding areas should be practiced both in the feedlot and in adjacent areas. Chemical treatments may also be used. Residual sprays can be applied to sunny areas where flies rest. A second chemical treatment is to use a tractor-mounted mist blower to spray a fine mist onto areas where adult flies are resting. This should be done once a week. The use of a feed additive will also assist in fly control. Rabon can be used as a pre-mix for feedlot animals, but each animal must eat the required amount daily for the additive to be effective. Experimentation is in progress in which parasitic wasps are being released in feedlots to control flies. (Rowe-East Central)

### 3281 - A3, A4, B1, C1, C2, C3
### BACTERIOLOGICAL IMPACTS OF NONPOINT SOURCES ON RECREATION LAKES,

Sanitary Engineer, Soil Conservation Service, Jackson, Mississippi
J. P. Burt
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, Lincoln, June 27-30, 1976, Paper No. 76-2062, 21 pg. 5 fig, 7 tab, 4 ref.

Descriptors: Water quality, Lakes, Agricultural runoff, Bacteria, Sampling, Water pollution control.
Identifiers: Non-point sources.

Bacteriological impacts of nonpoint sources on recreation lakes were studied. The planning process requires the evaluation of numerous variables related to recreation, and water quality has proved to be one of the most difficult to evaluate. The water quality evaluation procedure can be separated into 3 components — field reconnaissance, water sampling analysis, and projections of impoundment water quality. Specific parameters for which water samples are analyzed are: dissolved oxygen, pH, temperature, bacteria, specific conductance, dissolved solids, and toxic substances, color, taste and odor producing substances. The projection technique used in these studies for estimating future impoundment bacterial quality is based on the geometric mean of the bacterial concentration of bacteria in the reservoir. Results showed that nonpoint waste sources have a definite impact on the water quality of storm runoff, but the magnitude appears to be influenced by numerous factors that cannot be easily recognized and measured. Sampling a storm event provides a rough indication of the bacterial magnitude from nonpoint sources, but accurate modeling may prove to be difficult until additional research has been completed. Nonpoint source control may be too elusive, and a proposed recreation site may have to be relocated. Controlling inputs from grazing animals and wildlife is not easy. Although some nonpoint sources can be controlled with adequate waste management systems, proper management of the system is essential if it is to be effective. (Rowe-East Central)

### 3282 - B1, B2, B3, B4
### HOW THOSE MANURE TRANSFER PUMPS OPERATE.

R. E. Graves
Hoard's Dairyman, Vol. 121, No. 16, p. 933, August 25, 1976. 2 fig.

Descriptors: Waste storage, Pumps, Pistons, Liquid wastes, Solid wastes.
Identifiers: Waste management, Waste transfer, Hollow piston pumps, Solid piston pumps.

About 3 years ago, 2 types of large piston manure transfer pumps were introduced — hollow piston pumps and solid piston pumps. They usually are installed below the barn floor and include a hopper to receive the manure from a tractor scraper or barn cleaner conveyor. The pumps discharge through an 8 to 12-inch plastic pipe buried below the frost line. Allowable pipe lengths to storage vary from 100 to 300 feet. Hollow piston pumps have a flapper-type valve on the lower end of the piston. The piston runs in a loose-fitting square cylinder. There is another flapper-type valve on the end of the cylinder. The pumping mechanism, piston, and cylinder can be removed for exchange or repair. A mechanical pump jack or reversing hydraulic cylinder is used to drive the pump. In operation, the piston is pulled up through the manure in the bottom of the hopper on the return stroke. On the down or pumping stroke, the valve on the piston is forced closed and the manure is pushed through the cylinder. The manure then goes through the cylinder check valve and into the underground pipe. These pumps are most commonly used with more free-flowing manure when liquid storage is planned. Solid piston pumps are installed horizontally at the bottom of a concrete pit with the receiving hopper above it. This pit is about 5 by 12 ft. and 6 to 10 ft. deep. It must be kept dry. In operation, the piston is pulled completely out of the hopper to allow manure to drop down in front of it. On the forward stroke the manure is pushed into the pump cylinder and through a spring-loaded check valve. The cylinder opening contains a relatively close-fitting die. Die and edge of piston serve to shear off any material not completely in front of piston. The fact that the manure does not have to go through a piston or around connecting rods makes this pump well-suited for use where long straw or a low to bedding is used, although this pump is the more expensive of the 2 types. (Rowe-East Central).

### 3283 - A2, B1, B2, F1, F6
### A METHOD TO EVALUATE THE COST-EFFECTIVENESS OF OPEN BEEF FEEDLOT RUNOFF CONTROL SYSTEMS,

Agricultural Engineer, U. S. Environmental Protection Agency, Region VII, Kansas City, Missouri.
N. L. Klocke
Presented at the 1976 Mid-Central Meeting, American Society of Agricultural Engineers, St. Joseph, Missouri, March 19-20, 1976, Paper No. MC-75-605, 21 p. 5 fig, 19 ref.

Descriptors: Model studies, Costs, Feedlots.
Identifiers: Runoff control, Cost-effectiveness.

Two computerized models, which simulate the performance and estimate the costs of runoff control systems for open feedlots are reported in the literature. The purpose of this study was to evaluate whether or not these models could be used for a cost-effectiveness analysis of runoff control systems. The performance of 8 assumed configurations of feedlot runoff control systems was simulated by a continuous watershed model, which included the feedlot surface, runoff retention basins, and a disposal system. All of the results from the performance model were in terms of daily depths of runoff overflow, disposal and storage. The test feedlot was assumed to be located at Ames, Iowa. Study conclusions were: (1) When the runoff control system design storm was only one-third the average annual runoff, rigorous disposal management was required. (2) For feedlot sizes between 300 and 2000 head, each added increment of disposal management was less costly than the next increment of design storm. (3) The most effective system was the most costly. The least effective system was the least costly. (4) The most cost-effective system ranked second in both categories of least cost and highest effectiveness. (5) Improving management of runoff control systems resulted in more improvement in cost-effectiveness than increasing the design storm size. (6) For all of the runoff control systems, both unit cost and cost-effectiveness decreased rapidly due to economies of scale between 50 and 1000 head. Little change was found between 1000 and 5000 head. As may be seen by these conclusions, existing computerized cost and performance models can provide a basis for a cost-effectiveness analysis. (Rowe-East Central)

### 3284 - A3, A5, A8, B3, C2, E2
### GUIDELINES FOR MANURE APPLICATION IN THE PACIFIC NORTHWEST,

Extension Soil Scientist and Agronomist, Department of Agronomy and Soil, Washington State University.
D. O. Turner
Publication EM 4009, Cooperative Extension Service, Washington State University, February, 1976. 25 p. 10 tab, 6 ref.

Descriptors: Pacific Northwest, Crop production, Soil properties, Agricultural runoff, Nitrogen.
Identifiers: Land application, Loading rates.

Efficient use of animal manure in crop production can result in substantial savings in energy consumption for operations where there is adequate land for manure application within reasonable transport distances. Factors to be considered before field applying manure are: (1) Livestock feed must not be toxic. (2) Feed must be palatable to livestock. (3) Loading must be scheduled to fit the general farming operation. (4) There must be no deleterious effects on soil properties. (5) Runoff must be controlled so that there is no pollution of surface waters. (6) Water percolating through the soil profile must not carry excessive nitrate-nitrogen concentrations into groundwater aquifers. (7) Determination of loading rates and schedules should be made by the operator and related to his specific crops and soils. (8) There must be no adverse effect on crop production. Nitrogen is the major nutrient which more frequently limits crop yields and adversely affects water quality. Equations are given which provide a simple procedure for relating livestock source, handling methods, soils and crops to efficient use of manure as a fertilizer source. (Rowe-East Central)

### 3285 - B3, C2, D1, E3
### RECYCLED WASTE FOR FEED IS BECOMING ACCEPTED PRACTICE,

J. F. Blair
Feedlot Management, Vol. 18, No. 8, p. 24, August, 1976.

Descriptors: Recycling, Costs, Performance, Feedlots, Rations.
Identifiers: Refeeding.

Bill Langenegger of Hagerman, New Mexico, began feeding manure to his cattle in the regular rations about 3 years ago. The manure is dry and has no odor. It is prepared by running it through a large tub-like mixer by using a front end loader. The manure is ground and then placed in mixer-delivery trucks along with other ingredients. Protein content is nearly 12 percent. Mr. Langenegger uses 7 percent manure by weight in the starter and growing ration. This is then stepped up to 15 percent in the finish ration. There are also about 13 transition rations where the manure content is increased with each change. Other waste feeds are used too, such as milo stalks, gin trash, small grain straw and corn stover. The materials are analyzed and a nutritionist runs the results through a computer. Since there is so much of this wasted feed in almost every farming area, a feedlot company should make use of it. Daily weight gains are comparable to those of most Southwestern feedlots. Costs for Langenegger's top finishing ration is presently billed to customers at $103.67/ton. (Rowe-East Central)

### 3286 - B1, C2, D3, E3
### METHANE GENERATION FROM LIVESTOCK WASTE,

Extension Agricultural Engineer, Colorado State University
R. W. Hansen
Publication G 76-268, Cooperative Extension Service,

University of Nebraska, January, 1976, 4 p. 1 fig, 2 tab.

Descriptors: Recycling, Methane, Anaerobic digestion, Design.
Identifiers: Livestock wastes.

The conversion of organic materials, such as animal wastes, to an easily utilizable form of energy can be accomplished by a number of methods, one of which is anaerobic digestion. The basic elements of an anaerobic digester are described. In the digester system, a heat exchanger and thermostat may be used to maintain the proper temperature. The heat exchanger and thermostat can be either internal or external. Total bio-gas production will vary depending upon the organic material being digested, the digester loading rate, and the environmental conditions in the digester. Under ideal conditions (95 degrees F temperature and proper pH), it is possible to produce about 45 cubic feet of gas at atmospheric pressure from one day's manure from a 1,000 pound cow, or about 60 cubic feet of gas at atmospheric pressure per day from a 1,400 pound cow. Results showed that of the several types of energy capturing processes available, anaerobic digestion appears to be the most feasible for the majority of agricultural operations. Anaerobic digestion is capable of stabilizing most agricultural wastes while producing bio-gas or methane gas. Primarily, disadvantages are the amount of management required due to the sensitivity of the digesters, the high initial investment required for equipment, and the fact that the wastes still must be disposed of after digestion. (Rowe-East Central)

### 3287 - A5, A8, C2
### SOIL POLLUTION FROM CATTLE FEEDLOTS IN GEORGIA,

Department of Agronomy, Georgia University, Athens
H. W. Fordham
MS Thesis, Department of Agronomy, Georgia University, January, 1972, 44 p. 9 fig, 10 tab, 34 ref.
Descriptors: Feedlots, Cattle, Nitrates, Farm wastes, Georgia, Water pollution sources, Soil chemistry, Nutrients, Soil analysis.
Identifiers: Groundwater pollution sources.

Soil samples were taken from 21 beef cattle feedlots in Georgia. Samples to 122 cm. depth were taken upslope, within and approximately a 30 and 90 m downslope from the lots. Soil samples were analyzed for extractable $NO_3$, $NO_2$, $NH_4$, P, K, Ca, Mg, and for electrical conductivity, pH, and organic matter. Soil nitrate was considerably less in the Georgia feedlots than in those in the more arid regions in the West and Midwest. The average topsoil nitrate in feedlots was less than 20 ppm. Nutrients other than potassium did not show appreciable movement into the soil profile. It is concluded that pollution of groundwater from beef cattle feedlots is probably not significant in Georgia. (Giddens-Georgia University)

### 3288 - A11, B3, C3, D1, E3
### MICROBIOLOGICAL ANAYLSIS OF POULTRY ANAPHAGE,

Department of Poultry Science, Michigan State University, East Lansing
T. S. Chang, D. J. Currigan, D. W. Murphy and H. C. Zindel
Poultry Science, Vol. 53, p. 1242-1245, 1974. 1 tab, 26 ref.

Descriptors: Sampling, Microorganisms, Bacteria, Dehydration.
Identifiers: Poultry anaphage, Refeeding.

Poultry anaphage samples collected from various locations within the United States and dehydration machines were analyzed microbiologically in this study. Results showed that total bacterial counts of anaphage averaged about 466,900 microorganisms per gram with a range from 5,900 to 3,590,000. In terms of both frequency of isolation and total numbers, the genera Bacillus and Streptococcus predominated. No Salmonella, mold, Penicillium, Proteus, or Neisseria were isolated. It is felt that the poultry anaphage should be acceptable as a feed ingredient as long as no pathogenic organisms are isolated. However, it is preferable that the total bacterial count not be too numerous, so care should be taken not to recontaminate the anaphage after it is processed. (Rowe-East Central)

### 3289 - B2, C1, D3
### FLOW PATTERNS AND SEDIMENTATION IN LIVESTOCK OXIDATION DITCHES,

Agricultural Engineering Department, University of Illinois, Urbana
J. K. Mitchell and D. L. Day
Transactions of the ASAE, Vol. 19, No. 1, p. 119-122, January-February, 1976. 3 fig, 4 ref.

Descriptors: Aeration, Sedimentation, Slurries, Design.
Identifiers: Oxidation ditches, Flow patterns.

The main purpose of an aeration device is to provide the greatest possible absorption of oxygen by the slurry. The aeration device in an oxidation ditch for livestock waste treatment propels the liquid at a flow velocity which is supposed to be sufficient for maintaining the solids in a suspended state. When the velocity is insufficient to transport the particles, the particles will settle, and thus create a layer or mound of waste material without a dissolved oxygen supply. Tests were conducted to determine the flow patterns in a simple, oval-shaped recirculation ditch. The ditch was concrete, with a rectangular cross-section flow channel 1.07 m wide and 69 cm depth of flow. In the first test, two different aeration devices were used in an unmodified oval ditch and in the same oval ditch with end-section modifications. Ordinary tap water was used in the test. The first modification used was a guide-vane made of stainless steel, and the second was a teardrop "bulb" added to the end of the wall. Several diagrams are given which demonstrate the similarities and differences between the unmodified and modified ditch conditions. Another test was conducted to measure the sedimentation on a complex, U-shaped oxidation ditch which was beneath a large beef confinement unit. It was found that immediately down stream from the rotor aerator, there was little or no sedimentation and the greatest amount of sedimentation was found further down stream within the straight section. It was determined that in a large oxidation ditch, more than one type of aerator should be used. One type could be used for very high oxygenation capacity (rotor) and another type (propeller) for its high ditch bottom velocity capacity. (Edwards-East Central)

### 3290 - B3, D2, E3, F1, F6
### CONVERSION OF ORGANIC WASTE TO FUEL GAS,

Research Scientist, Natural Resources Research Institute, Wyoming University, Laramie.
J. L. Cox, W. G. Willson and E. J. Hoffman.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 100, No. EE3, p. 717-732, June, 1974. 3 fig, 6 tab, 19 ref.

Descriptors: Organic wastes, Recycling, Fuels, Costs, Equipment.

Experimental results of a new and novel concept for the gasification of carbonaceous material to a high beating value fuel gas are presented. The chemistry of the conversion is examined in reference to the feed materials and experimental variables. Experiments have shown that a variety of solid organic waste materials can be converted to gaseous fuel products composed essentially of $CH_4$, $CO_2$, and $H_2$ with a $CO_2$-free heating value that in many instances exceeds 7.92 kcal /l, a value generally accepted for substitute natural gas. A multiple catalyst, single-stage reactor system was used in the investigation. Temperatures of 600 degrees C-700 degrees C gave satisfactory conversions with all the feed materials, but it is anticipated that somewhat lower temperatures may also show adequate conversions and improved product composition. Although it would be unrealistic to project economics on the basis of these preliminary investigations, it is apparent that the catalyst cost needs the most attention in this respect. Such questions as catalyst alternatives, catalyst life, recoverability, and regeneration deserve particular attention. Some efforts are currently being directed at answering these questions. (Rowe-East Central)

### 3291 - B3, C1, D1, E3
### A MATHEMATICAL DRYING MODEL FOR POROUS MATERIALS: PART I - THEORY,

Assistant Professor, Biological and Agricultural Engineering, Department, North Carolina State University, Raleigh
D. H. Willits, I. J. Ross, G. M. White and H. E. Hamilton
Transactions of the ASAE, Vol. 19, No. 3, p. 556-561, May-June, 1976. 5 fig, 24 ref.

Descriptors: Mathematical models, Drying, Equations, Porous media, Fertilizers, Feeds.
Identifiers: Poultry manure, Refeeding.

The basis of the drying model developed in this study to describe the drying of poultry manure is the concept of evaporation from an interface which recedes into the body as drying proceeds. Since poultry manure as excreted possesses no fixed geometry, the model was developed for formed manure. The problem of drying a highly porous body, becomes that of defining the rate at which the interface moves through the body. Two separate versions of the evaporative interface model were developed. They are described in terms of equations. The behavior of the interface temperature for each is also described in terms of equations. (Rowe-East Central)

### 3292 - B3, C1, D1
### A MATHEMATICAL DRYING MODEL FOR POROUS MATERIALS: PART II - EXPERIMENTAL RESULTS,

Assistant Professor, Biological and Agricultural Engineering, Department, North Carolina State University, Raleigh.
D. H. Willits, I. J. Ross, G. M. White and H. E. Hamilton
Transactions of the ASAE, Vol. 19, No. 3, p. 562-568, May-June, 1976. 4 fig, 6 tab, 16 ref.

Descriptors: Mathematical models, Drying, Model studies, Temperature.
Identifiers: Poultry manure, Cylinders, Spheres, Evaporative interface.

Two versions of a semi-empirical model based on the concept of a receding evaporative interface were developed to describe the drying of formed poultry manure. The two-parameter version was developed for cylindrical geometries to describe the behavior of the interface temperature. The one-parameter version was developed for both cylindrical and spherical geometries to describe the interface temperature. Data obtained from the drying of poultry manure formed into 2 shapes (cylindrical and spheres) for diameters of 25.4, 19.1, and 12.7 mm for cylinders and 31.8, 25.4, and 19.1 for spheres at air temperatures of 65.6, 93.3, and 121.1 C were used for evaluating both versions of the model. When the one-parameter version was compared to an exponential drying model, the results indicated that both models performed equally well in describing the drying of poultry manure. However, the evaporative interface model had the following advantages over the exponential model: (1) It directly incorporated most of the variables that influence drying into a single expression. (2) It could be more easily extended to situations not covered by available drying data because of the reasonable behavior of the predicted values of $h_o$ and p. (3) It provided a more complete understanding of the mechanisms of drying highly porous materials. (Rowe-East Central)

### 3293 - B3, E3
### WILL SOLID WASTES BURY US?,

J. A. MacDonald
Engineering News Record - Probing the Future, Vol. 192, No. 18, p. 251-261, April 30, 1974. 5 fig.

Descriptors: Solid wastes, Recycling, Waste disposal.
Identifiers: Europe, United States, Japan, Waste management.

The U. S. generates 4.4 billion tons of solid waste per year: 1.7 billion tons of animal waste, 1.7 tons mineral waste, 640 million tons agricultural waste, 230 million tons urban waste, 140 million tons industrial waste. It is projected that by the year 2000 the U. S. will have to deal with 12 billion tons of solid waste. The U. S. produces over 1 ton of solid waste annually for every man, woman, and child in the U. S. Figures for other countries are given: Japan, 800 lb; West Germany, 300 to 660 lb; Holland, 660 lb; Belguim, 638 lb; England, 635 lb; Italy, 572 lb; and France, 506 lb per capita per year. These figures are expected to grow by 5 to 8 percent each year. With this as an introduction, the author goes on to say that in order to meet the demands that will be placed upon us in solid waste management a total commitment must be made immediately. He then discussed possible directions that could be taken in the updating of solid waste technology. The author says that total recycling of natural resources from the processing of solid waste and garbage is today a reality in handling municipal and commercial solid wastes. The challenge in the future lies in throwing off prejudices that have fettered wide-scale application of resource recovery concepts, and in making resource recovery a necessary part of materials-use practices. (Solid Waste Information Retrieval System)

### 3294 - A11, B2, B3
### HOUSING OF BEEF CATTLE,

J. J. Troon
Agriculture, Vol. 77, No. 9, p. 416, 418, 421, September, 1970.

Descriptors: Cattle, Liquid wastes, Solid wastes, Waste storage.
Identifiers: Housing, Waste Management, Slatted floors.

Loose housing is being considered for cattle during the second winter or finishing period in buildings where there is no attempt to achieve control over the internal environment. Wastes may be handled as solid, semi-solid, or as a liquid and the decision on which method to use may well be influenced by any existing waste disposal methods on a particular holding. Economy of straw used as litter can be achieved by bedding only part of the yard and making the area adjoining the manger a solid floor. If the waste is to be handled as a liquid, the area adjoining the mangers can be slatted and the effluent stored beneath the slats. Where animals are loose housed on long litter, it is not advisable to have both solid and liquid manure to handle, which would mean extra disposal equipment. The Brambell Committee on Animal Welfare recommends that only half of the area be slatted to produce an inhibiting effect. However, the use of a slatted passage between two rows of cubicles enables the liquid to be stored beneath the slats and maintains a balance between solid and slatted areas. A passage width of 8 ft. combined with usual cubicle dimensions 7 ft. long by 3 ft. wide is effective. Experience has shown that slats 5 in. wide with a 1 ½ in. gap are satisfactory and that concrete slats are less slippery than steel slats. The slats should be designed to carry a load of 500 lb./square foot. (Solid Waste Information Retrieval System)

### 3295 - A2, A4, A6, A13, B1, D3, E2, F1, F2
### FARM WASTE DISPOSAL,

K. B. C. Jones
Agriculture, Vol. 77, No. 4, p. 165-167, April, 1970.

Descriptors: Confinement pens, Cattle, Poultry, Odor, Water pollution, Feedlot runoff, Aesthetics, Economics, Legal aspects, Aeration.
Identifiers: Housing, Great Britain, Land spreading.

Housing of cattle and poultry has created difficulties with manure storage and disposal because of smells, unsightliness, and water pollution by runoff from yard concrete or manure heaps. With profit margins at their present levels nobody can insist on a return to ranching or free range, but high standards of manure management are required to prevent justifiable complaints of nuisance. Regular land spreading of manure will help to keep odors down, and aeration before pumping will ultimately remove much of the smell from liquids. Silage liquor is universally offensive, but cannot be helped. Farmers can cooperate the nonagricultural interests by limiting activities at week-ends and on public holidays when there are more city dwellers in the countryside. The legal position with regard to waste disposal is both complicated and diffuse. There is no tidy consolidating act which defines the whole situation clearly. Legal action for nuisance, e.g., smell or noise, may be brought either at common law, or under section 92 of the Public Health Act, 1936. The principal object of the action is to obtain either an injunction or an abatement order against the offender. The Rivers (Prevention of Pollution) Acts 1951 and 1961 forbid the discharge of farm or trade effluents into a stream or watercourse unless it has been agreed to in writing by the Local River Authority. (Solid Waste Information Retrieval System)

### 3296 - B2, E2, F1
### GROUP OPERATIONS: WASTE DISPOSAL BY TANKER,

W. K. Hall
Agriculture, Vol. 79, No. 10, p. 436-437, October, 1972.

Descriptors: Liquid wastes, Equipment, Economics.
Identifiers: Land spreading.

The article discusses use of liquid manure tankers on the farm. These tankers are seldom operated to capacity on any farm. There may be situations in which it is advantageous to share a tanker and its associated labor in order to reduce the costs invested in machinery. On small farms a group may operate a tanker and improve waste handling. Larger tankers can do more work for a given tractor and labor imput and can handle wastes of varying dry matter, as well. The working rate of any tanker depends on tanker capacity, filling rate, and transport distance. The right kind of tanker for a particular project in hand must be chosen on the basis of such factors as distance and dry matter content of waste. The article outlines a possible scheme arranged among three farms for joint operation of a 700-ton tanker filled by vacuum and emptied under pressure. Accommodation and reason are stressed in this example. (Solid Waste Information Retrieval System)

### 3297 - A4, B2, C1, C2, E2
### EFFLUENT DISPOSAL,

Agricultural Engineering Advisory Officer of Palmerston North, Great Britain
F. W. Phillips
Agriculture, Vol. 77, No. 3, p. 23-37, March, 1970. 21 fig, 5 tab.

Descriptors: Water pollution, Dairy industry, Spray irrigation, Effluents, Waste disposal, Confinement pens, Physical properties, Chemical properties.
Identifiers: Land disposal.

This four-part series of articles covers the following: sources of agricultural wastes, stream pollution, dairy wastes, and spray irrigation. The trend toward farming at a greater intensity has meant that the dung and urine which was previously voided in the paddocks will become an increasing problem. In every intensive agricultural system and problem of disposal of unwanted material becomes an important part of the enterprise, and planning for it has to be incorporated from the start. The use of oxygen by organic material in the stream is very important as it effects the whole pattern of life within the stream. As animal wastes discolor the water, contain suspended solids, and have a very high oxygen requirement, their effect on a stream is quite marked and rapid. It is generally cheaper and easier to return all the wastes to the land and so avoid any discharge to streams. Methods of disposal of dairy wastes are discussed: pouring wastes down the drain, a sump to catch suspended solids, ponding, sump and tanker-honey wagon manure spreader trailer, pumping, and spray irrigation. The spray irrigation method of disposal, if properly managed, completely overcomes the problem of direct pollution from cowsheds to streams. All of the shed washings are returned immediately to the pasture, thus gaining maximum benefit from the available manurial value of the wastes. In planning spray irrigation systems, there are a number of points to consider: labor, volume of wastes, soil, soil cover, topography, and management. (Solid Waste Information Retrieval System)

### 3298 - A6, B3, C2, D1, E3, F1
### PROTEIN WITHOUT POLLUTION,

Commercial Manager, Process Division, Douglas-Rownson Limited
J. Taylor
Engineering, Vol. 212, No. 11, p. 1081-1083, November, 1972. 1 fig.

Descriptors: Drying, Poultry, Fertilizers, Feeds, Economics, Proteins, Design, Odor.
Identifiers: Dried poultry wastes, Refeeding, Great Britain.

The author describes a method of drying poultry manure developed by Douglas-Rowson, Ltd. The dried manure, which is 27 percent by weight of the wet manure, is 38 percent protein, and can be used both as fertilizer and feed additive. The author claims that a new profit of 8 pounds sterling per ton can be achieved by processing the poultry manure and utilizing it by this method. (Solid Waste Information Retrieval System)

### 3299 - A8, B1, C2, E2
### A COMPARATIVE STUDY ON CANALS SPOIL AND FARMYARD MANURE AS CALCAREOUS SOIL CONDITIONERS,

Soil and Water Research Institute, Agricultural Research Center
M. A. Negm, H. K. Bakhati, S. H. Abdel-Malik, E. M. Abdel-Naeim, A. I. Mitkees, and H. M. Hassan
Agricultural Research Review, Vol. 51, No. 2, p. 1-8, March, 1973. 8 tab, 11 ref.

Descriptors: Soil amendment, Crop response, Farm wastes, Chemical properties.
Identifiers: Canals spoil, Land disposal, Loading rates, Residual effect.

An experiment was conducted to show the effect of canals spoil and farmyard manure as a calcareous soil conditioner on maize yield as well as their residual effect on the following crop (wheat). The study took place at Nobaria Experimental Station, near Alexandria. Six treatments were utilized in a complete randomized block design. The treatments were replicated 8 times. Treatments were: (1) Control, (2) 70 ton/feddan of canals spoil. (3) 5 ton/feddan of farmyard manure, (4) 35 ton/feddan of canals spoil, + 2.5 ton/feddan farmyard manure, (5) 70 ton/feddan of canals spoil 5.0 ton/feddan farmyard manure, and (6) 10 ton/feddan of farmyard manure. Results indicated that maize and wheat yields were increased successively by increasing the levels of farmyard manure. Applying canals spoil alone had little effect on yield. Applying farmyard manure plus canals spoil gave better results. Residual effect of these additions on the following crop was clear, but renewing the addition before the next crop had pronounced effects. Canals spoil or any other amendment should not be used without first analyzing it for harmful salts. (Merryman-East Central)

### 3300 - A6, A11, B1, E2
### FLOOR TYPES AND VENTILATION ON BEEF ANIMAL PERFORMANCE,

Engineer, Sedimentation Control, North Carolina Department of Natural and Economic Resources, Winston-Salem
G. D. Miller, J. I. Sewell, and J. B. McLaren
Transactions of the ASAE, Vol. 19, No. 2, p. 322-325, March-April, 1976. 2 fig, 5 tab, 12 ref.

Descriptors: Ventilation, Performance, Odor.
Identifiers: Floor types, Knee swelling, Waste management, Slatted floors, Slab floors.

Primary objectives of the study were to determine the effects of floor types and ventilation on animal performance and knee swelling. A secondary objective was to develop waste management criteria for slatted-floor systems. A sheet metal beef finishing barn with 2 rows of 10 pens separated by a feeding alley and having open sides and enclosed ends was completed at The University of Tennessee Aluminum Co. of America (Alcoa) Farm Bulls and steers weighing from 204 kg to 253 kg each were used in the tests started in 1971 and concluded in 1974. The cattle were fed a finishing ration until they reached slaughter weight (about 430 kg). Few problems were experienced with the cattle on feeding trials except during summers. During a 1-year test when ventilation was not provided, bulls fed on concrete slabs, aluminum slats, and concrete slats were similar with respect to feed efficiency and rate of gain. During summer only, some cattle exhibited swelling of knee joints; and all cattle showed signs of discomfort. Cattle in the ventilated slat pens gained an average of 1.05 and 1.10 kg/animal day more than those in the unventilated slat and unventilated slab pens, respectively. Bulls on ventilated slabs exceeded those on unventilated slats and unventilated slabs in feed conversion. Performance differences were not statistically significant. Problems associated with slatted floor systems were high facility investment, odors after spreading waste, and providing satisfactory environmental conditions during summer. (Rowe-East Central)

### 3301 - A6, A11, B2, C2, D3, E3
### RECYCLING AEROBICALLY TREATED WASTE WATER TO LAYING HENS,

University of Illinois at Urbana-Champaign, Urbana, Illinois 61801
H. S. Johnson, D. L. Day, C. S. Byerly, and S. Prawirokusumo
Manuscript submitted to Poultry Science, April, 1976, 9 p. 4 tab, 7 ref.

Descriptors: Wastewater treatment, Aerobic treatment, Recycling, Poultry, Performance, Nitrates, Odor.
Identifiers: Oxygen level.

A study was performed to evaluate the performance of layers that had their waste products aerobically treated and recycled in their drinking water. Aerobic treatment enhanced the wastes by killing pathogens, upgrading the organic matter into single cells with high protein content, and decreasing the wastes' odor. Two groups of White Leghorn pullets were used in this experiment. A mini-oxidation ditch was installed under the experimental cages. The water level in the ditch was maintained at about 30 cm. and the contents were agitated with an aerator. Results showed that the aerator incorporated more oxygen into the oxidation ditch than necessary. As a result, the dissolved oxygen level increased from 4.7 to 6.0 ppm from the fourth to sixth week. Normally, a level of 1 to 2 ppm is desirable. The nitrate levels increased even more sharply during this 2-week period. Egg production dropped sharply during this time. However, the birds were able to recover much of their production loss after being subjected to these levels, or slightly lower ones, for several weeks. (Rowe-East Central)

### 3302 - A11, B1, C1, C2, E3
### REFEEDING WASTES,

Feedlot Management, Vol. 18, No. 7, p. 12, July, 1976.

Descriptors: Feeds, Potassium, Sodium, Manganese, Nutrients, Confinement pens, Feedlots.
Identifiers: Refeeding, Minerals, Roughage, Housing.

Scientists of U.S. Department of Agriculture Agricultural Research Service and the University of Nebraska have found that feces and manure from housed cattle on a low roughage ration generally meet the requirements for feeding as a high roughage ration. However, supplemental manganese may be needed. Researchers found that wastes from outdoor feedlots contain 45-95 percent soil and are not suitable for refeeding because of low feed value. The study also showed that the suitability of excreted materials for refeeding declines as the amount of roughage in the original ration increases. Feces from a high roughage ration, for example, could be reused only as the roughage component of a ration. They would be equivalent to those from a low roughage ration if potassium, sodium, and manganese were added. Researchers found that the roughage level in the ration influenced gross energy, crude fiber, crude protein, all forms of nitrogen, potassium, phosphorus, manganese and other mineral elements in the wastes. (Rowe-East Central)

### 3303 - D2, D3, E3, F1
### SEARCH FOR ALTERNATE FUELS LEADS TWO CONGRESSMEN, VOLKSWAGEN, TO METHANOL,

Feedstuffs, Vol. 48, No. 16, p. 8, April 19, 1976.
R. H. Brown

Descriptors: Fuels, Research and development, Costs, Recycling.
Identifiers: Methanol, Volkswagen, Automobiles.

Scientists are doing lab work and some congressmen, in taking a look at substitute fuels, have become interested in methanol, a gas derived from agricultural or minicipal wastes, coal or natural gas. Senator Alan Cranston and six other senators are seeking passage of a bill for road tests on a large scale using methanol as a fuel for the family automobile. Meanwhile, Volkswagen has been doing some research on its own in cooperation with the German government. Preliminary results indicate that methanol produced from coal, natural gas and livestock wastes is a "mid-term" possibility, while over the longer haul hydrogen is a possibility. Volkswagen is using 45 vehicles in the testing program. A gasoline-methanol mixture consisting of 85 percent gasoline and 15 percent methanol is being used in 22 VW Rabbits, 12 VW buses and 11 Audi 100's. The vehicles will be driven almost 20,000 miles a year and so far only minor adjustments have been needed to adapt the engines to methanol gasoline. Hopefully, the studies will show that it will be possible to quickly shift to the methanol-gasoline. (Rowe-East Central)

### 3304 - A11, B3, C2, E3
### SCIENTISTS QUESTION USE OF MANURE FOR RECYCLING,

Beef, Vol. 12, No. 8, p. 41, April, 1976.

Descriptors: Recyling, Performance, Nutrients, Calcium, Copper, Magnesium.
Identifiers: Refeeding, Toxicity, Digestibility, Minerals, Ensiling.

Several studies were done to test the value of manure in refeeding. Although chemical analysis of feedlot manure makes the manure look good as a potential feed, there are problems. It is hard to get livestock to eat the manure and about 80 percent of what they do eat becomes manure again because the digestibility is low. Other tests were performed to see if concentrations of certain minerals in the manure that might be harmful increased each time it was recycled. The tests revealed that continued recycling increased calcium, copper and magnesium concentrations in the dried excreta, but that the increases were not sufficient to be harmful. Other research was done utilizing pregnant beef cows. The researchers concluded that manure in combination with barley could be fed as a supplement to pregnant range cows as an alternative to high quality protein supplements such as cottonseed meal. University of California animal scientists W. N. Garrett and J. L. Hull, based on their research as well as the work of others, did not recommend using feedlot manure as a feed. "It's marginal, at best right now," they agreed, adding that research with ensiling the manure and feeding it in other forms may hold some hope for the future. (Rowe-East Central)

### 3305 - A8, B2, C1, C2, E2
### RENOVATION OF LIQUID DAIRY AND MILKING PARLOR WASTES,

Assistant Professor, Agricultural Engineering Department, Delaware University, Newark
W. F. Ritter, R. P. Eastburn, and J. R. Harris, Jr.
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, June 27-30, 1976, Paper No. 76-4031, 25 p. 5 fig, 9 tab, 10 ref.

Descriptors: Liquid wastes, Lysimeters, Chemical properties, Soil profiles, Soil properties, Physical properties, Leachates.
Identifiers: Dairy wastes, Milking parlor waste.

Research on land application of milk-parlor wastes and liquid dairy wastes was conducted at the University of Delaware. Four lysimeters were constructed from plywood and lined with 4 mil polyethylene. Two of the lysimeters contained a loamy sand soil and 2 of the lysimeters contained a silt loam soil. Milking parlor waste (MPW) was applied to one of the silt loam lysimeters and one of the loamy sand lysimeters. Liquid dairy waste (LDW) was applied to the other 2 lysimeters. Influent and leachate samples were collected from each lysimeter and analyzed for COD, nitrate-nitrite nitrogen, ammonia, organic nitrogen, ortho phosphorus, total phosphorus, zinc and copper. Soil samples were taken at the end of the experiments from each lysimeter and analyzed for pH, magnesium, calcium, potassium, phosphorus, Kjeldahl nitrogen, zinc, copper and organic matter. Conclusions that were drawn fron the research were: (1) Soil filtration is capable of removing over 90 percent of the COD, over 99 percent of the phosphorus and over 80 percent of the nitrogen from livestock wastes. (2) Temperature did not affect the removal of COD and phosphorus, but had some effect on nitrogen removal. (3) The milking parlor waste was more effectively treated than the liquid dairy waste. (4) Milking parlor wastes and liquid dairy wastes contain low concentrations of zinc and copper. (5) Phosphorus movement will increase in a soil profile with increased phosphorus applications. (6) The pH of the soil profile of acid soils will increase with high applications of livestock wastes. (7) The organic matter content of the upper layers of the soil profile of loamy sand or sandy loam soils will increase with high applications of livestock wastes. (Rowe-East Central)

### 3306 - B2, D3, E3, F6
### THEY'RE PACKING UP WASTE PONDS,

Chemical Week, Vol. 116, No. 24, p. 37, June 11, 1975.

Descriptors: Recycling, Anaerobic treatment, Liquid wastes, Chemicals, Fuels.
Identifiers: Packed-bed biological reactor, By-product recovery.

Union Carbide's Nuclear Division, which operates Holifield National Laboratory in Oak Ridge, Tennessee, has developed a technique (Anflow) for packing an anaerobic waste treatment pond into a column. The Anflow unit is an upflow packed-bed biological reactor in which liquid wastes are pumped into the bottom to travel upward through the packing in which anaerobic microorganisms have been implanted. This method of treatment reduces both land requirements and treatment time. Retention times in the equipment are as low as 4 hours. The biggest selling points for Anflow are chemical recovery and fuel generation. Carbide estimates that 13 trillion cu.ft. /year of methane could be recovered from all wastes in the U.S. But this would be mainly solid wastes. Anflow could recover methane as an off-gas during treatment of liquid wastes from starch and food processing, and from domestic sewage. More valuable products also can be recovered, including butane-diol from starch waste, sulfur from kraft process black liquor wastes, alcohols from wastes containing sugars. Researchers already have adapted the Anflow process to production of ethanol and report recoveries in excess of 15 percent from pure sugar feeds containing trace elements. (Merryman-East Central)

## 3307 - A1, A3, A4, A9, A11, A12

### RESOURCES UNDER PRESSURE--WATER

Water Pollution Research Laboratory, Department of the Environment, Stevenage, England
M. Owens
Intensive Agriculture and the Environment, North Western European Region Symposium, The University, Newcastle-Upon-Tyne, September 19-21, 1973, p. 33-39. 1 fig, 6 tab, 30 ref.

Descriptors: Water pollution, Agricultural runoff, Pesticides, Herbicides, Fertilizers, Phosphates, Nitrogen, Biochemical oxygen demand, Fishkill.
Identifiers: Agricultural wastes.

In recent years, the agricultural industry has endeavored to increase crop yields and minimize livestock space to such a degree that fertilizers, pesticides, farm wastes and other materials constitute a real threat to the waters which they pollute. Some of these materials have harmful effects indeed. Certain organic wastes have a high BOD and cause the water to lose oxygen necessary for aquatic life. Some of these substances encourage growth of undesirable organisms and slimes in the water. Livestock wastes entering surface waters may introduce bacterial, parasitic, or viral diseases that may infect other animals or man. Feedlot runoff, which has a high concentration of ammonia, can cause fish-kills and can interfere with chlorination at the water works. Pesticides, which often enter surface waters as a result of land runoff, may cause fish-kills; however, short-term exposure of herbicides to aquatic life (in the amounts normally expected to occur) appear not to have toxic effects. Agricultural wastes as pollution sources are hard to treat, mainly due to the difficulties in collecting them at their sources. Seasonal variations of polluting quantities (as in sheep dips, vegetable washings, etc.) also add to the difficulty. (Sanders-East Central)

## 3308 - A4, A6, A7, A8, A11, A12, B2, C2, D1, D3, E2, E3

### RESOURCE MANAGEMENT—FARM EFFLUENTS,

Ministry of Agriculture, Northern Ireland
J. S. V. McAllister
Intensive Agriculture and the Environment, North Western European Region Symposium, The University, Newcastle-Upon-Tyne, September 19-21, 1973, p. 71-79. 8 tab, 24 ref.

Descriptors: Effluents, Slurries, Nutrients, Gases, Waste storage, Odor, Water pollution, Soil contamination, Diseases, Aerobic treatment, Drying, Separation techniques.
Identifiers: Toxicity, Land disposal.

Slurry, silage effluent, and dairy washings are the main liquid or semi-liquid wastes produced in agriculture. Slurry, which is a mixture of feces and urine of farm animals with varying amounts of water, is produced in the greatest quantity and presents the major disposal problem. Slurry should be collected in a way which will minimize the loss of plant nutrients such as phosphorus, potassium, and calcium. It is also important to know that if methane, carbon dioxide, carbon monoxide, ammonia or hydrogen sulphide gases are released in excessive amounts during slurry decomposition, they can be toxic. For this reason, many existing collection and storage systems are hazardous to stock and workers. It is therefore necessary to improve the condition of such storage systems. One form of improvement would be to provide some form of aeration treatment for the slurry in the storage tank and regularly flush the dung channels with effluent from this treatment. Any disposal system must guard against pollution. Therefore, when land disposal is used, it is important that the land area be adequate. Three interdependent factors decide the amount of slurry which can be safely spread on land—soil type, cropping system, and climate. Problems associated with land disposal of slurry are: (1) odor, (2) disease transmission, (3) water pollution which occurs when untreated slurry or manure is allowed to overflow from tanks or storage pits into open ditches or streams, and (4) problems which arise in soil and plants. Other methods of slurry disposal are being studied. These include: (1) aerobic treatment of slurry to reduce biochemical oxygen demand, (2) drying poultry manure for use as a packaged manure or for inclusion in feeds for ruminants, and (3) separation of the solid and liquid fractions of slurry with subsequent disposal of treatment of the fractions separately. (Edwards-East Central)

## 3309 - A3, A6, B2, B3, B4, C2, D3, E2

### RESOURCE MANAGEMENT--THE ANIMAL MANURES PROBLEM,

Agricultural Institute, Dublin
V. A. Dodd
Intensive Agriculture and the Environment, North Western European Region Symposium, The University, Newcastle-Upon-Tyne, September 19-21, 1973, p. 80-87. 2 fig, 4 tab, 8 ref.

Descriptors: Waste treatment, Waste disposal, Waste storage, Annerobic conditions, Nutrients, Confinement pens, Poultry.
Identifiers: Oxidation ditch, Odor control, Swine.

The problem of manure disposal has arisen for the following reasons: (1) substitution of chemical fertilizers for animal manures in crop production, (2) trend to separate feed production from animal production, resulting in increased costs for manure disposal, (3) current housing techniques together with the growth of intensive animal production units on limited land areas, which are often ill-chosen, (4) properties of animal manures, and (5) expansion of urban centers to rural areas and the public's general concern for the environment. One possible solution to the waste disposal problem is the oxidation ditch which consists of two primary parts — continuous open channel ditch in an oval or race-track like shape which holds the waste, and an aeration rotor motor driven by an electric motor for supplying the necessary oxygen. The waste and water mixture is circulated around the ditch and returned to the rotor at intervals where oxygen is churned into it. Growth of aerobic bacteria, which decomposes the organic matter and produces water, carbon dioxide, and stable solids called activated sludge, is promoted by the mixture of oxygenated water and waste. Land has always been used by man as the ultimate disposal medium for many kinds of wastes, and is possibly still one of the most efficient means of disposal. Several questions are being raised which center around how much and for what periods of the year can manure be applied to land. It is necessary, when land is being used as the disposal medium, to be sure that there is no surface runoff, and that drainage water does not carry with it excessive amounts of nutrients and organic compounds. Another problem associated with manure is odor. Manure stored under anaerobic conditions gives off gases such as ammonia and hydrogen sulphide. The most effective method for odor control is the prevention of the conditions under which odors are generated. Several methods of odor control are given. (Edwards-East Central)

## 3310 - A2, A8, B2, C2

### PROTECT TREES FROM FEEDLOT RUNOFF,

District, Extension Forester, University of Nebraska
N. E. Jennings
Nebraska Farmer, Vol. 118, No. 18, p. 30, September 18, 1976.

Descriptors: Feedlots, Agricultural runoff.
Identifiers: Trees.

Feedlot runoff kills trees. In areas where livestock wastes flow through windbreaks or around trees, the trees soon die. Studies indicate that livestock wastes increase salt and ammonia concentrations in the soil and tie up some of the nutrients. To protect trees, the feedlot surface should be graded away from them. Alternatively, feedlot runoff can be channeled in a narrow ditch through the trees. In planning a new feedlot, ideally it should drain to the east and south. Trees should be planted to the north and west for protection. (Merryman-East Central)

## 3311 - B2, C1

### CHECKING OUT STICKING SLURRY,

M. Looker
Pig Farming, Vol. 21, No. 8, p. 78-79, August, 1973.

Descriptors: Slurries, Design, Flow, Physical properties.
Identifiers: Swine, Housing.

The Agricultural Research Council is investigating the problem of sticking slurry in the handling of animal wastes. The work is to be carried out by the Building Research Station at Garston, near Watford, Herts. The physical characteristics and the flow properties of pig slurry will be investigated in relation to waste handling facility design. An experimental piggery is being erected that will hold 45 fatteners from roughly 100-200 lb liveweight. These will be divided into 3 pens of 15, each with a 4 foot wide dunging passage kitted out with concrete slats. The piggery will be raised 6 feet off the ground to allow easy access to the slurry channel, which is 4 feet wide x 2 feet 3 inches deep and is to be suspended beneath the slats on 2 special heavy-duty weighers. This will enable the exact weight of slurry output to be accurately recorded. It will also be possible to adjust the fall on the channel. In the experimental piggery, trials will not be confined to just gravity-operated systems. Recirculation systems using fluid waste from a nearby lagoon pumped back to the slurry channel with a low horse-power pump will also be studied. Detailed records will be kept of the type of food and how much is fed to the pigs. The water flow to each nipple drinker and washing down hoses will be measured and the electricity supply will be metered. Initial tests will be with floor-feeding but, for comparative purposes, other feeding systems may be tried out at a later stage. At each stage, the flow properties of the slurry and its flow behavior by gravity will be measured. These experiments are not only being designed to give an indication of the best channel shape and slope, but also to give a clue to best type of surface within the channel. The experimental fattening house is due to be completed very shortly and trials will start as soon as it is stocked. (Ott-East Central)

## 3312 - A7, A11, A12, B2, B4, C2

### DANGER-SLURRY,

A. Phelps
Pig Farming, p. 42-45, June, 1970. 6 fig.

Descriptors: Slurries, Air pollution, Gases, Safety, Methane, Carbon dioxide, Hydrogen sulfide, Ammonia.
Identifiers: Swine.

The problems concerning dangerous gases from slurry pits are examined in a question and answer type format. Slurry gases are generated by bacterial activity. Most toxic among these gases are: methane, carbon dioxide, hydrogen sulfide, and ammonia. There are documented cases of swine being killed by such gases, which are usually released as a result of "slurry disturbance" or agitation. If ventilation were adequate, agitation beneath slatted floors would not be such a problem. Management precautions are: (1) Don't let slurries stored in channels and cellars build up to within 12 inches of the slats. (2) When slurry is stored in an underground tank near the piggery, all connections between the pit and drainage channels should be closed to prevent gas blow-back when the effluent is disturbed. If the pit is enclosed, it should also have an outlet pipe to permit the escape of lighter-than-air gases as they are generated. Recommended safety precautions for farmers and their employees are: (1) Always secure manholde covers and suction hoses so they cannot fall into the slurry tank. Covers should be made larger than openings so they cannot fall through, and hoses can be secured to vacuum tankers with safety chains. (2) Never enter a slurry tank without first ventilating it for at least 20 minutes. Either wear a safety harness and have 2 men standing by on the rope in case of emergency or wear a gas mask or breathing apparatus. (3) Never stand over manholes, or sluice gates, or slatted floors when the effluent underneath is being agitated, flushed out, sucked or pumped. Farmers should put up notices warning of the gas hazard at all danger spots in and around their piggeries. Because methane, ammonia and hydrogen sulfide can be explosive, smoking should not be allowed when emptying a slurry pit. Also lighted cigarettes should not be thrown into slatted slurry pits. (Ott-East Central)

## 3313 - A2, B2, C2, D3

### IONIC COMPOSITION OF CATTLE FEEDLOT RUNOFF,

A. Liu
MS Thesis, Department of Civil Engineering, Colorado State University, Fort Collins, November, 1975, 79 p. 10 fig, 15 tab, 62 ref.

Descriptors: Feedlots, Agricultural runoff, Cattle, Chemical oxygen demand, Biochemical oxygen demand, aerobic treatment, magnesium, bicarbonates.
Identifiers: Ionic composition.

A study was conducted in 1969-1970 to investigate the ionic composition of cattle feedlot runoff. The runoff was simulated by making 1 percent cattle manure aqueous solutions from a manure suspension consisting of 10 grams of cattle feedlot manure and 990 milliliters of distilled water. The ionic composition of the simulated runoff and the effect of aeration on BOD and COD were studied. The ionic analysis results showed that magnesium and bicarbonate were the major positive and negative ions, respectively. The specific conductance value was 1,400 µmhos/cm at 25° C and $CaCO_3$ was deposited by the solution. It was felt that the manure aqueous solution would be satisfactory for almost all soils as far as the sodium-absorption-ratio was concerned. Aeration treatment data showed that, after 7 days aeration, there was a 74 percent removal of ultimate BOD at 24° C. The study established that the cattle manure mixture did have a high degree of aerobic treatability. (Rowe-East Central)

## 3314 - A6, A11, A12, B2, E2, F1

### FIELD TESTS OF LIQUID MANURE SYSTEMS AT TWO DAIRIES,

Associate Professor, Department of Agricultural Engineering, Tennessee University, Knoxville
J. W. High, Jr., J. R. Owen, and J. I. Sewell
Tennessee Farm and Home Science, Progress Report No. 76, October-December, 1970, p. 3-5. 2 fig.

Descriptors: Liquid wastes, Waste storage, Costs, Odor, Safety, Tennessee.
Identifiers: Holding Tanks, Land spreading.

In 1967, 2 concrete liquid manure holding tanks were constructed at the Dairy Experiment Station at Lewisburgh and at the Middle Tennessee Experiment Station at Spring Hill for a cost of $0.85/cu. ft. storage capacity. Construction costs, management data, and operational problems have been recorded since these tanks were put into operation. In these liquid manure systems, manure was stored until weather conditions, cropping systems, and labor schedules allowed the manure to be spread on fields. Each concrete pit was accompanied by concrete slabs for easy loading of the pit, equipment for agitating the manure, and equipment for pumping the liquid wastes for hauling and field spreading. The liquid manure systems made possible more sanitary conditions during the winter months than would have been possible with conventional hauling methods. Objectionable odors were not normally present except during agitation and pit unloading and for a short period after the manure was spread on fields. During summer months, scraping of the lots was done early in the morning before the manure had dried appreciably in order to make agitation easier. It was found that caution should be taken to exclude materials which could damage or clog a pump and safety precautions should be taken for farm workers and animals in relation to the flammable and poisonous gases produced by such liquid manure pits. (Rowe-East Central)

## 3315 - C2

### MICRONUTRIENT CONTENT OF FARMYARD MANURE OF THE PUNJAB,

Department of Chemistry and Biochemistry, Punjab Agricultural University, Ludhiana, India
G. S. Mann, S. Mangat and S. M. Sood
Journal of Research, Punjab Agricultural University, Vol. 10, No. 2, p. 203-206, June, 1973. 3 tab, 11 ref.

Descriptors: Sampling, Iron, Manganese, Molybdenum, Copper.
Identifiers: India, Micronutrients, Farmyard manure.

Because very little information is available about the micronutrient content of the farmyard manure being used in India, a study was conducted to evaluate the manure being used in rural areas of the Punjab. The manure was analyzed for iron, manganese, molybdenum, copper, nitrogen, potash, phosphorus, organic matter, and pH. Thirty-nine samples of farmyard manure were collected from different villages of the Faridko, Garhshanker, Banga, Nawan Shahr, Dehlon and Ludhiana N.E.S. blocks of the Punjab State. The samples were oven dried at 60 degrees C for 72 hours. They were then ground and sieved through a 1 mm sieve for analysis. The overall average value for iron was found to be 1.3019 percent. The average manganese value was 40.6 ppm. The average value for copper was 46.3 ppm. The molybdenum value varied from 0.9 to 15.9 ppm. (Rowe-East Central)

## 3316 - A8, B1, C2, D3, E2, E3, F1, F3

### THE ANAEROBIC DIGESTION OF CATTLE MANURE,

J. B. Lane
MS Thesis, University of Minnesota, September, 1971, 93 p. 16 fig, 18 tab, 73 ref.

Descriptors: Anaerobic digestion, Methane, Nitrates, Costs, Equipment, Economics.
Identifiers: Soil amendment.

Anaerobic digestion of cattle manure was investigated in terms of gas production and volatile solids reduction. Experiments were performed with the following objectives: (1) comparison of gas production and temperature in adiabatic and isothermal batch digesters, (2) gas production in digester enriched with protein supplement, (3) determine the effect on gas production and volatile solids reduction of aerobic pretreatment of the substrate, and (4) comparison of nitrate production in soil amended with fresh manure. A prototype field digester was then designed and the materials costs estimated. For 10 dairy cows and 10 beef cows, dome digesters of 8.5 ft and 7.0 ft in radius were required. Installed costs were estimated at $2500 for each digester. The return on investment from the methane generated would be 25 percent and 53 percent, respectively. Hence, anaerobic digestion of cattle wastes is not only feasible but economically attractive to the farmer or feedlot operator. However, more technical research, especially at the field pilot plant level, is needed to assure this attractiveness. (Rowe-East Central)

## 3317 - A11, B1

### EFFECTS OF DUNG BEETLE ACTIVITY ON THE NUMBER OF NEMATODE PARASITES ACQUIRED BY GRAZING CATTLE,

Animal Parasite Research Laboratory, Agricultural Research Service, U. S. Department of Agriculture, Tifton, Georgia 31794
G. Fincher
Journal of Parasitology, Vol. 61, No. 4, p. 759-762, August, 1975. 1 tab, 10 ref.

Descriptors: Nematodes, Cattle, Grazing, Parasites.
Identifiers: Dung beetles.

A study was conducted to determine the effects of dung beetle activity on the number of nematode parasites acquired by parasite-free calves grazing contaminated pastures under natural conditions. Twelve steers with naturally acquired parasite infections were used to contaminate 3 pastures (4 cows to each pasture) with feces containing parasite eggs. Six parasite-free calves were then allowed to graze the pastures for 43-45 days. Two calves, grazing a pasture with a dung beetle population rendered lower than normal by screening and trapping, acquired 9 times more parasites than 2 calves that grazed a pasture on which captured beetles had been released. Two calves that grazed a pasture with a natural dung beetle population acquired 4 times more worms than the calves on the pasture with the increased beetle population. The 2 major genera of nematodes present (*Ostertagia* and *Cooperia*) were found definitely to be significantly reduced in number by dung beetles. (Rowe-East Central)

## 3318 - A6, B1, D2

### INCINERATION SYSTEM FOR CONTROLLING NOXIOUS ODORS IN A LAYER HOUSE,

Department of Agricultural Engineering, College of Agriculture, Pahlavi University, Shiraz, Iran
R. P. Kachru
Environmental Research, Vol. 9, No. 3, p. 342-348, 1975. 4 fig, 2 tab, 7 ref.

Descriptors: Incineration, Carbon dioxide, Water, Design, Temperature, Turbulence.
Identifiers: Odor control.

An attempt was made to eliminate obnoxious odors produced by poultry manure by incincerating it. Incineration of gases requires 3 basic conditions: (1) The combustion elements must be raised to their autoignition temperature in the presence of sufficient oxygen to complete the chemical reactions. (2) Gases must be retained at that temperature for a sufficient length of time to permit the oxidation to proceed until only $CO_2$ and water remain. (It was found that a minimum of 0.5 seconds at about 1400° F is required for the complete combustion of obnoxious gases produced in a layer house). (3) Turbulence: The degree of intimate mixing of the air for oxidation with the waste fuel will affect the incinerator performance significantly. (In general, either mechanical or aerodynamic means are utilized to achieve the intimate scrubbing and mixing of the air and fuel.) Direct flame incineration has proven to be the most positive method of continuous elimination of the obnoxious odorous compounds. Heat recovery, when utilized with this system, can cut down the expenses on fuel consumption by an appreciable amount. This combustion recovery heat can be used either for a heat exchanger placed in the system or for heating the "layer" house in the winter time. Total initial investment should be computed and profitability of the incineration system should be analyzed in relation to the individual poultry production setup in order to determine the system's feasibility in individual cases. (Rowe-East Central)

## 3319 - A3, A5, A6, A10, B2. B3, B4, C1, C2, D1, E2, F1

### SETTLING AS A METHOD FOR PRETREATING FEEDLOT RUNOFF,

Extension Agricultural Engineers, Agricultural Engineering Department, Purdue University, West Lafayette, Indiana
J. C. Nye, D. D. Jones, and A. L. Sutton
Department of Agricultural Engineering Mimeo, Purdue University, West Lafayette, Indiana. 1974, 26 p. 9 fig, 7 tab.

Descriptors: Feedlots, Agricultural runoff, Settling basins, Waste storage, Irrigation, Groundwater pollution, Odor, Vectors, Liquid wastes, Solid wastes, Economics.
Identifiers: Pretreatment, Settling channels, Infiltration area, Holding ponds.

Before selecting a particular waste management and runoff control system for a feedlot, the settling system should be considered. The runoff control system is composed of 3 functional elements: a pre-treatment unit, a storage unit and a disposal unit. The pretreatment unit may be a settling basin or a settling channel. When the lot is cleaned only a few times a year and where large amounts of manure are carried off the lot in runoff, a settling basin should be used since it has more room for solids storage and can be more readily cleaned. If the lot is cleaned frequently, the volume of solids will be less and a settling channel may be adequate. The storage element may be either a holding pond or an infiltration area. Holding ponds take less land out of production than infiltration areas, but may not be acceptable in areas where the water tables are very near the soil surface or where the soil is underlain with fractured limestone or sand. If a holding pond is used, some sort of irrigation system will be needed to de-water the holding pond when it becomes full. Advantages of settling systems are: (1) Farm labor can build a settling system with equipment that is usually found on a farm. (2) If an infiltration area is used, the management is very simple. (3) The settling basin will reduce the organic loading on a runoff holding pond or a lagoon, reduce pond odor problems and lengthen pond life. (4) Smaller irrigation equipment can be used when settling system is used to treat runoff before it enters the runoff holding pond. (5) Solid manure handling can be used to handle the settled solids if the settling basin or settling channel is properly designed. Disadvantages are: (1) If settling system is constructed of concrete, it can be expensive. (2) Flies and mosquitoes may breed in the channel if it is not cleaned after runoff events. (3) A settling channel and infiltration area will take land out of crop production. (4) Solids which are removed from the system may have to be stored in a solid manure storage area. (Edwards-East Central)

### 3320 - A8, B1
### SURVIVAL OF THE SUGARBEET CYST NEMATODE IN THE ALIMENTARY CANAL OF CATTLE,

Farm Advisor in Imperial County
D. G. Kontaxis, G. P. Lofgreen, and I. J. Thomason
California Agriculture, Vol. 30, No. 3, p. 15, March, 1976. 1 tab.

Descriptors: Sugar beets, Nematodes, Cattle.
Identifiers: Manure.

The cyst nematode can be disseminated from field to field by equipment, cultural implements, irrigation water, manure from grazing cattle, and by any other means which transfers soil from one place to another. In this study, sugarbeet roots remaining in a field with high nematode infestation were collected. Soil samples taken just prior to harvesting had an average of 10,280 viable eggs per 100 grams of dried soil. The roots were sectioned into small pieces and fed along with a conventional milled ration to 6 yearling steers for 10 consecutive days. Feces and a sample of roots were collected from each animal. The study showed that eggs in cysts passing through the digestive systems of cattle remained viable. This was evidenced by the white females (new generation) obtained from the roots of the sugarbeet seedlings. Material eaten by cattle started passing in the manure about 3 days after feeding. Most eaten material was excreted within about 7 days of feeding. (Rowe-East Central)

### 3321 - A1, A4, A7, A12, B1, F2
### LEGISLATION PERTAINING TO INTENSIVE AGRICULTURE AND THE ENVIRONMENT,

Ministry of Agriculture and Fisheries, the Netherlands
J. P. Van Zutphen
Intensive Agriculture and the Environment, North Western European Region Symposium, The University, Newcastle-Upon-Tyne, September 19-21, 1973, p. 96-98.

Descriptors: Legislation, Air pollution, Water pollution, Agriculture, Pesticides, Permits.
Identifiers: Netherlands, Manure tanks.

Several laws have been introduced in the Netherlands with the intention of balancing agriculture with a clean environment. Three of these laws are the "Public Nuisance Act," the "Pollution of Surface Waters Act", and the "Air Pollution Act". The Public Nuisance Act prohibits the erection, operation and modification without an official permit of any installation that may constitute an external danger or cause external damage or a nuisance. The Pollution of the Surface Waters Act was instituted to curb the pollution of surface waters such as rivers, streams, and coastal waters. The Air Pollution Act was instituted to reduce to a minimum the discharging of noxious substances (including gaseous substances producing noxious odors) into the atmosphere. Another law, the "Pesticides and Allied Substances Act", prevents a pesticide from being used before its approval. Amendments to this Act plan to provide better ways of assuring that surplus pesticides and empty packages do not contaminate water sources. The government also encourages farmers to burn natural gas to cut down on pollution caused by combustion of heavy fuel oils. Manure removal is controlled by the previously mentioned Pollution of Surface Waters Act which mandates a permit for most waste discharges. "Manure banks" have been established, which provide transportation of manure to areas where it can be put to good use. (Sanders-East Central)

### 3322 - A8, B1, C2, E2, F1
### RENEWED EMPHASIS ON BEEF FEEDLOT WASTES AS FERTILIZER: IMPACT ON FARM ECONOMICS AND ENVIRONMENTAL QUALITY,

Professor of Agricultural Economics
A. Jacques, M. Freeman and D. Badger
Oklahoma Current Farm Economics, Vol. 48, No. 2, p. 5-10, June, 1975. 2 tab, 5 ref.

Descriptors: Feedlots, Fertilizers, Soils, Crop response, Cattle, Economics, Nutrients.
Identifiers: Land application.

In the fall of 1974, a survey of 24 beef cattle feedlot operators, 10 farmers, and 3 commercial manure handlers was taken in the Oklahoma and Texas panhandle to determine the supply and demand situation for beef feedlot waste and resulting environmental quality implications. Indications are that recent economic and other events have combined to eliminate much of the livestock waste solids problem in the southwestern beef feeding states, as related to both state and federal environmental quality regulations. Results showed that fertilizer prices have increased 200 to 300 percent in the last 3 years. Consequently, farmers have turned increasingly to beef feedlot wastes as a valuable source of plant nutrients. Beef feedlot operators had a difficult time disposing of these wastes in the late 1960's and early 1970's. Most were losing money hauling the manure. Now farmers in the survey are convinced that the nutrient value of beef feedlot wastes is sufficiently high to pay the current rate of $2.50 to $3.50 per ton required for applying beef feedlot waste to their land. Increasing quantities of beef feedlot wastes in drier climate zones such as the Southwest likely will be applied to both irrigated and dryland crops and pastures. (Rowe-East Central)

### 3323 - A6, B3, C2, D3
### ODOR CONTROL AND ANAEROBIC DEGRADATION OF SWINE MANURE MIXED WITH DIGESTER SLUDGE,

J. L. Roll
M.S. Thesis, University of Illinois, 1973, 106 p. 32 fig, 30 tab, 28 ref.

Descriptors: Sewage sludge, Degradation, Anaerobic conditions.
Identifiers: Odor control, Swine, Mixing.

The 4 objectives in this study are as follows: (1) Determine potential of adding municipal digester sludge to swine manure as a method of controlling odors of swine manure under anaerobic conditions. (2) Determine the ratio of digester sludge to swine manure which gives the best anaerobic digestion of swine manure. (3) Determine the effects of continuous mixing of the digester contents versus mixing for only 30 minutes a day. (4) Determine whether microbial action due to the digester sludge, buffering capacity of the digester sludge, or dilution by the digester sludge is the cause of any odor control that may be observed during the research. Time degradation, odor panel and off-gas analyses were performed in an attempt to determine what the mechanism of odor control was. Three trials were made and in all three, digesters 1, 2, 3, 4, and 5 contained the following ratios (on a volume basis) of liquid swine manure to municipal digester sludge: 2:1, 1:1, 1:2, 1:6, and 1:10 respectively. It was found that digester sludge is valuable in setting up good anaerobic activity in manure. The better anaerobic activity resulted in odor control and better degradation of the manure. The best degradation was observed in the digester with the most odor, so a trade-off may be required. If good solids reduction is desired, some odor will have to be tolerated. Perhaps a closed digester is the answer. (Edwards-East Central)

### 3324 - A8, C2, C3, E2
### POULTRY MANURE PHYTOTOXICITY,

Division of Agricultural Chemistry, 5 Parliament Place, Melbourne 3001, Victoria, Australia
I. R. Minchinton, D. L. Jones, and J. P. L. Sang
Journal of the Science of Food and Agriculture, Vol. 24, No. 11, p. 1437-1448, November, 1973.

Descriptors: Poultry, Phytotoxicity, Crop response, Litters.
Identifiers: Land disposal, Growth deformation.

Reports from field personnel and growers in Western Australia, Victoria, and New South Wales indicated the presence of a plant toxin in deep litter fowl manure. Affected crops have included vegetables, in particular tomatoes, ornamental nursery crops (both field and container grown) and ornamental cut flower species. This investigation was conducted to check the possibility that the toxin was different from 2,4-D (previous reports from Western Australia suggested that the toxin was 2,4-D) and to isolate and identify the toxin. Secondary investigation centered around the examination of poultry feed additives. Extracts were made from toxic Victorian and West Australian samples by shaking 20 g of manure with 50 ml of water and filtering. Bioassays were conducted on the extracts and also on concentrations of 2,4-D ranging from 0.1 to 5 parts / million alone and in combination with a non-toxic manure extract. The results of this and other phases of the experiment show that phytotoxicity associated with the use of poultry deep litter was caused by the impurity 4-amino-3,5-dichloro-2,6-lutidine in clopidol, used in feeds to control coccidiosis. The results of this investigation are in direct contrast to previously published literature which inferred that the damage to plants was due to 2,4-D contamination of wheat seed. The results of the second poultry trial show that phytotoxicity only results when the impurity is ingested by poultry, indicating that an active metabolite is formed in the alimentary system of the bird. The bioassay showed that the metabolite is biologically very active. Bioassay dilution studies on the resulting manure showed that on the basis that the diet contained the major impurity at 0.625 part/ million, taking account of the digestibility coefficient of 66 percent and assuming complete conversion of the impurity to the metabolite, 0.16 part /million of 4-amino-3,5-dichloro-2,6-lutidine in the feed would cause phytotoxicity and 0.078 part / million would cause no damage. (Cameron-East Central)

## 3325 - A2, A4, A5, A8, A12, E2, F1, F2

### IMPACT OF FERTILIZERS AND AGRICULTURAL WASTE PRODUCTS ON THE QUALITY OF WATERS,

Organisation for Economic Co-operation and Development
Impact of Fertilizers and Agricultural Waste Products on the Quality of Waters, Organisation for Economic Cooperation and Development, Paris, 1973, 72 p. 4 fig, 9 tab., 47 ref.

Descriptors: Water quality, Water pollution, Groundwater pollution, Nutrients, Fertilizers, Eutrophication, Organic wastes, Economics, Leaching, Nitrogen, Phosphorus, Agricultural runoff, Erosion, Irrigation, Legal aspects, Public Health.
Identifiers: Waste management, Environmental effects, Land application, Educational aspects.

Agricultural waste products (particularly animal wastes) and fertilizers make substantial contributions of nutrients to surface waters, thus contributing to the development of eutrophication. This report, based on an investigation conducted by the Organisation for Economic Co-operation and Development Water Management Sector Group on Eutrophication of Surface Waters and its control, gives an evaluation of nutrient contribution to surface waters and indicates measures and practices that may be employed to reduce such contributions. Sources of nutrient enrichment of surface waters include industrial discharges, urban discharges, agricultural activities, and rainfall. The sources of nutrient loss from soil include those from soil organic matter, soil minerals, fertilizers and all types of organic manures. Mechanisms for nutrient losses which occur from agriculture to the water system are leaching, surface runoff, erosion and direct discharge of animal wastes. These vary considerably, depending on the agricultural system (e.g. crop rotation and fertilizer practice) and the geographical characteristics (e.g. climate, soil type, and slope.) The most serious source of nutrient losses from agriculture to water is from operations with high livestock densities. Since the range of climatic and geographical conditions, and the range of customary agricultural practices vary very greatly from region to region, only a general guide to remedial measures can be given. Factors that must be considered when proposing a change in customary practices include environmental aspects, employment, economic feasibility, need for food production, practical applicability and cost. A change in the education of the farmer is needed, which not only considers the economic factors of fertilizing operations, but also the environmental consequences of nutrient losses. (Penrod-East Central)

## 3326 - A4, A7, A8, B1, C2, D3, E3

### METHANE FROM FARM WASTES,

D. M. Paulin
The Soil Association, Vol. 2, No. 4, p. 10, 20, April, 1974, 1 fig.

Descriptors: Methane, Recycling, Fertilizers, Biological treatment, Organic wastes, Design, Anaerobic digestion, Copper, Air pollution, Water pollution, Soil contamination.
Identifiers: Refeeding, Swine, Scotland.

The experiments in progress at the Rowett Research Institute and the Scottish Farm Buildings Investigation Unit, North of Scotland College of Agriculture, were started originally not so much for possible energy production as because of overall public concern about control of land, air, and water pollution. It was realized at once that biological treatment of farm wastes could lead to efficient recycling, but it was also realized that such treatment as is used in domestic sewage systems was not adequate because of the very much higher content of organic material in farm wastes. The team examining the problems, therefore, decided to experiment with anaerobic digestion, using wastes from an intensive pig unit. After experimenting with varying rates and different load mixtures, it was found that a mixture of sow-house and fattening-house waste (3.5 percent solids), with a loading rate of 100 gal /day and at a digester temperature of 35 degrees C, increased gas production to about 500 cu ft /day, comprising 68 percent methane and 32 percent carbon dioxide. However, the actual volume of gas produced depends on the composition of the waste as well as the volume. Three things seem within reach in the foreseeable future: (1) The production of useful fertilizer, complicated in the case of pig slurry by the indestructibility of the copper now apparently included in pig nutrition, (2) The production of feed recycled from the treated wastes, with the same reservations concerning pig wastes, and (3) The production of methane gas with potential for heating and for energy for static farm machinery. The ultimate goal is to produce a design for a cheap, easily run anaerobic plant for the ordinary farm. (Rowe-East Central)

## 3327 - A4, A7, A8, B1, D3, E2, F1

### FARM WASTE COMPOSTING PROCESS,

Anonymous
Effluent and Water Treatment Journal, Vol. 15, No. 9, p. 482-488, September, 1975. 1 fig.

Descriptors: Pollution control, Slurries, Solid wastes, Design.
Identifiers: Composting, Land disposal.

Dr. K. R. Gray and Dr. A. J. Biddlestone of the Chemical Engineering Department lead the Compost Studies Group at the University of Birmingham, which for the past 5 years has been studying the application of composting to the treatment of farm manure slurries. The Ministry of Agriculture is encouraging farmers to return to their fields as much animal manure as possible. The new process will enable farmers to do this without the previously attendant risk of pollution of the air, neighboring water courses or the soil. The key to the process is the efficient use of the head from a slurry-straw composting reaction to evaporate the water from the slurry, thereby leaving a solid compost product with no liquid effluent. The equipment consists of 4 specially constructed cubes maintained under forced aeration. In each cube a batch of slurry and straw is composted for about a month; the cubicle is then emptied and refilled. In Week 1, for a particular cubicle, slurry and the straw are carefully blended and the cubicle filled. The straw matrix filters out the suspended solids from the slurry and absorbs much of the liquor. In Week 2, the mass reaches its maximum composting temperature. The drainage liquor from the recycle tank is carefully sprayed over the composting mass and becomes totally evaporated into the stream of air being blown through the matrix. In Weeks 3 and 4, composting continues under forced aeration conditions but without any liquid recycle. The temperature starts to fall back and the cubicle is emptied at the end of week 4. The weight of the mass falls to 1 /3 that of the original charge, owing to the enormous evaporation of water. The technique can handle manure slurries from any source—pigs, cattle, or poultry. The capital installed cost of a manufactured unit is likely to be about 10 pounds per pig place, 100 pounds per cow place. Labor needs for a 1000 pig or 100 cow unit are about ½ hour per day for cubicle filling and 1-2 hours per week for cubicle emptying and stockpiling the compost. (Ott-East Central)

## 3328 - A9, A11, B1, D2

### EVALUATION OF B-EXOTOXIN OF BACILLUS THURINGIENSIS BERLINER FOR CONTROL OF FLIES IN CHICKEN MANURE,

3231 E. Lester Street, Tucson, Arizona
R. J. Barker and W. F. Anderson
Journal of Medical Entomology, Vol. 12, No. 1, p. 103-110, 1975. 1 fig, 8 tab, 16 ref.

Descriptors: Insecticides, Feeds, Toxicity, Performance, Poultry.
Identifiers: Fly control, Animal health.

The objectives of this study were to determine the efficacy and safety of B-exotoxin in feed and in water for control of flies in chicken manure, to establish and to describe early symptoms of overdosage to birds to check possible long-range toxic effects, and to obtain a rough indication of the ultimate fate of exotoxin. Because it takes chickens about a week to adapt to new cages or rations, the same birds were used in successive tests. First, they were used to establish what level of toxin should be fed to control flies in feces. Next, soluble and insoluble salts were compared. Finally, dosages were increased until a margin of safety between control of flies and harm to birds could be established. Results were: The B-exotoxin was highly toxic to chickens whether added to feed as a calcium or a sodium salt or to water as the sodium salt. Early poisoning symptoms were loss of vigor, reduced feeding, and undersized eggs. Reduced feeding was not a consequence of palatability. Exotoxin caused severe gizzard erosion, enteritis, and proventriculitis. The exotoxin degraded when manure liquified and lost the ability to kill house fly larvae under such conditions. House flies acquired resistance to B-exotoxin after 6 months continuous selection from larval exposures. The $LD_{95}$ increased 30 times, to the point that larvae grew with 600 ppm of exotoxin in the medium. (Rowe-East Central)

## 3329 - A11, B1, C1, C2, E3, F1, F2

### UTILIZATION OF WASTES AND BY-PRODUCTS IN ANIMAL FEEDS,

Agricultural Research Council, Poultry Research Center, King's Buildings, West Mains Road, Edinburgh EH9 3JS, Scotland
R. Blair
Feedstuffs, Vol. 46, No. 39, 1974. 8 tab, 33 ref.

Descriptors: Recycling, Byproducts, Feeds, Energy, Proteins, Minerals, Performance, Legal aspects, Economics.
Identifiers: Plant wastes, Animal wastes, Industrial wastes, Dried poultry waste, Dried poultry litter.

The potential of various wastes and byproducts as animal feedstuffs is surveyed. Included are animal wastes and byproducts, plant wastes and byproducts, and various industry wastes such as bakery wastes, wood wastes, household wastes, vegetable wastes and surplus, and waste potatoes. In the animal waste category, dried poultry waste (DPW) and dried poultry litter (DPL) receive particular attention. Among the points made are: (1) DPW is variable in composition and contains a high content of nitrogen. (2) The main difference in DPW and DPL is the higher content of crude fiber in DPL due to the admixture of droppings with litter. (3) The nutritive value of poultry waste is higher for ruminants than for non-ruminants because ruminants can utilize uric acid and some fiber. (4) Studies indicate that DPW can be used as a source of energy, protein and minerals by poultry and, under certain price situations, may be an economic feed ingredient. (5) Studies indicate that both DPW and DPL are suitable protein sources for beef cattle although there may be problems in diet formulation due to the low energy value of the wastes. (6) The main loss of nitrogen from raw poultry waste is due to fermentation and for ruminant feeding, the waste is more valuable if collected and dried soon after being voided. (7) One detrimental feature of DPL is its content of lignin (about 8 percent), which ruminants are unable to degrade and which also reduces the digestibility of the carbohydrate with which it is combined. (8) Recycling animal waste is banned in most EEC countries and in the United States. In the United Kingdom, the use of DPW is not prohibited unless it can be shown that the feed contains deleterious ingredients. (Rowe-East Central)

## 3330 - B2, B3, C2, D3, E2, E3

### METHANE DIGESTERS FOR FUEL GAS AND FERTILIZER,

The New Alchemy Institute-East, Box 432, Woods Hole, Massachusetts
R. Merrill and Y. Merrill, ed.
Newsletter No. 3, The New Alchemy Institute, 1973, 46 p. 34 fig, 10 tab, 69 ref.

Descriptors: Anaerobic digestion, Recycling, Methane, Fertilizers, Sludge, Organic wastes, Algae, Fish, Design.

Identifiers: Methane digesters.

This study: (1) presents a general background of the raw materials and processes of digestion, (2) discusses some preliminary ideas for using methane gas and sludge, (3) describes 2 designs for building simple working models of digesters, and (4) develops feedback from readers who are working on digester projects across the country. From a biological point of view, digesters can be considered as a culture of bacteria feeding upon the converting organic wastes. The basic gas producing reaction in the digester is: Carbon plus water = methane plus carbon dioxide. The composition and fuel value of bio-gas from different kinds of organic wastes depends on (1) the temperature at which digestion takes place, and (2) the nature of the raw material. Digesters can be designed for batch feeding (filling all at once, sealing, and emptying when the raw material stops producing gas) or for continuous feeding (feeding a little, regularly, so that gas and fertilizer are produced continuously). The digesters require little daily attention. Anaerobic digestion is about 60-70 percent "efficient" in converting organic waste to methane. Most solids not converted into methane settle out in the digester as a liquid sludge. This sludge may be used as a fertilizer and soil conditioner or as a stimulant in ponds for algae growth, which in turn encourages fish growth. The sludge may also be used in a sludge-algae-methane system in which green algae is grown on diluted sludge, then harvested, dried and digested to produce methane for power and sludge for recycling. Actual digester design information is given on how to build a sump digester and how to build an inner tube digester. (Rowe-East Central)

## 3331 - A2, A4, A7, A8, B2, C2, E2, F1, F2

### PERFORMANCE OF SYSTEMS CONTROLLING RUNOFF FROM FEEDLOTS,

Research Assistant, Department of Agricultural Engineering, University of Illinois, Urbana 61801
E. C. Dickey and D. H. Vanderholm
Illinois Research, Vol. 18, No. 1, p. 10-11, Winter, 1976. 1 fig.

Descriptors: Agricultural runoff, Feedlots, Illinois, Regulations, Water pollution, Air pollution, Soil contamination, Design, Costs, Nitrogen, Phosphorus, Potassium, Soil analysis.
Identifiers: Runoff control, Land application.

Although present Environmental Protection Agency (EPA) regulations make runoff control mandatory for large feedlots, EPA and the Illinois Pollution Control Board are now proposing livestock regulations which will apply to all livestock operations regardless of size. These regulations will require modification of many facilities and will present small and medium sized operations with the problem of economically controlling polluted runoff. A runoff control system usually consists of a runoff collection component such as a channel, a settling basin to settle out a portion of the manure solids, and a holding pond to store the liquid after settling. Liquid from the holding pond is usually spread on nearby cropland as a supplemental water supply and a source of nutrients. Because runoff control systems are few in number and fairly new to Illinois, several beef, dairy, and swine operations with runoff control systems in central and northern Illinois have been monitored since the spring of 1974 with the following objectives in mind: (1) to determine whether installations are preventing air, water, and soil pollution, (2) to discover any management problems that could be eliminated by modifying the system, (3) to determine the adequacy of present design criteria, and (4) to study the balance of nutrients, particularly nitrogen, through runoff systems. The runoff control systems under study were found to be helping prevent water and soil pollution. Design capacities for the settling basins and holding ponds were found adequate. None of the systems caused odor complaints. Both liquids and solids were found to be sources for supplying soil nutrients. The quality of the holding pond water was largely determined by the size of the lot, number of animals, and management of the lot and runoff control systems. (Edwards-East Central)

## 3332 - B1, C2, D3, E3, F1

### ENERGY AND NUTRIENT CONSERVATION IN SWINE WASTE MANAGEMENT,

Associate Professor, Agricultural Engineering Department, Clemson University, Clemson, South Carolina 29631
C. L. Barth and D. T. Hill
Presented at the 1975 Annual Meeting, American Society of Agricultural Engineers, University of California, Davis, June 22-25, 1975, Paper No. 75-4040, 16 p. 3 fig, 10 tab, 15 ref.

Descriptors: Recycling, Methane, Energy, Fertilizers, Economics, Anaerobic digestion, Design.
Identifiers: Swine.

Even though animal manures have always been highly regarded as a source of nutrients for crop production, recent increases in the cost of inorganic nutrients have made it clear that animal manures can be an economical, as well as a practical, source of nutrients. Animal manures can also serve as an alternate source of energy through methane production. Using animal manures for methane production is attractive because, after the energy is harvested, the nutrients remain for possible recycling on croplands. Farmers can save money by converting their gas fueled equipment to use methane. One major problem related to gas utilization, however, is that because of the expensiveness of storage of methane gas, the gas must be used at a rate approximating its production. Possible uses of methane gas on a livestock farm are: (1) water heating for the farm residence and/or livestock, (2) power for feed grinding, (3) family food preparation, (4) dead animal incineration, and (5) pig and chicken brooding. An anaerobic digester, which is still being used for experimentation with the goal of completing the unit so that it can be a more effective demonstration of the technology and so that it will be useful for further studies on maximizing the conservation of energy and nutrients from swine and other animal wastes. (Edwards-East Central)

## 3333 - B2, C2, D3, F6

### THE EFFECT OF AERATION ON THE GASES PRODUCED BY SLURRY DURING STORAGE,

Department of Agriculture, Agricultural and Food Chemistry Research Division, Belfast, Northern Ireland
R. J. Stevens and I. S. Cornforth
Journal of the Science of Food and Agriculture, Vol. 25, p. 1249-1261, 1974. 10 fig, 2 tab, 19 ref.

Descriptors: Aeration, Gases, Slurries, Aerobic treatment, Oxygen, Microorganisms, Waste storage, Hydrogen sulfide, Carbon dioxide.
Identifiers: Anaerobic treatment, Decomposition.

The effect of oxygen supply on the gases produced by decomposing slurry was measured in a series of laboratory experiments. The slurry mixture for the experimental treatment contained 2.9 percent total solids (105 degrees C), 0.7 percent total solids (550 degrees C), 0.26 percent total nitrogen, 0.12 percent ammonia-nitrogen and 1.40 percent total carbon. Aeration treatments were applied in duplicate using identical apparatuses. All experiments were done at laboratory temperature, approximately 18 degrees C. The amount of $O_2$ consumed and carbon dioxide produced increased with oxygen supply. Decomposition was the greatest when air was passed through slurry, 31 percent of initial total carbon being evolved as carbon dioxide in 14 days. Results showed that readily decomposable substrates, such as volatile fatty acids, were rapidly metabolised under aerobic conditions. Only trace amounts of ethylene were produced in any treatment. $CH_4$ and $H_2S$ was prevented from forming if the anaerobic treatment was preceded by an aerobic treatment. The evolution of $H_2S$ from settled slurry was prevented by surface aeration. Hydrogen sulfide was released, however, once surface-aerated slurry was agitated. A combination of aerobic followed by anaerobic treatments caused the greatest loss of nitrogen from slurry as $NH_3$ and $N_2O$. The use of $N_2$ to create anaerobic conditions was not ideal since volatile constituents were purged out of solution, resulting in a lowered activity of methane-producing bacteria. (Cameron-East Central)

## 3334 - A7, A11, B1

### EFFECTS OF AERIAL AMMONIA, HYDROGEN SULFIDE AND SWINEHOUSE DUST ON RATE OF GAIN AND RESPIRATORY-TRACT STRUCTURE IN SWINE,

University of Illinois, Urbana 61801
S. E. Curtis, C. R. Anderson, J. Simon, A. H. Jensen, D. L. Day, and K. W. Kelley.
Journal of Animal Science, Vol. 41, No. 3, p. 735-739, September, 1975. 1 tab, 23 ref.

Descriptors: Air pollution, Ammonia, Hydrogen sulfide, Dusts, Gases.
Identifiers: Swine, Animal health, Respiratory tract.

This study comprised 7 trials intended to determine the effects of exposure to ammonia ($NH_3$), hydrogen sulfide ($H_2S$) and dust at various levels, alone and in various combinations, on the gross and microscopic integrity of the respiratory tract of the pig. Four dynamic-type, air-pollutant exposure chambers manufactured out of stainless steel and glass were used. Each chamber had an exposure zone comprising a cube, 1.22 m. on a side, giving a volume of 1.81 meters. Each chamber could hold 4 pigs to a body weight of 50 kg or 2 pigs to 100 kilograms. Aerial levels of $NH_3$, $H_2S$ and dust used as treatments in these trials with pigs were as high or higher than those usually encountered in enclosed swine houses. Results showed: with the exception of mild conjuctivities and blepharitis in one of the pigs exposed to $NH_3$ (50 ppm), there was no evidence of structural alterations in any organ or tissue due to experimental treatment. Turbinates, trachea and lungs of all pigs were classified as "normal" after both gross and microscopic examination. Air factors in swine houses may influence the incidence and severity of chronic pneumonia in swine. However, these results indicate that the rate of gain and respiratory-tract structure of growing pigs, which are free of respiratory disease, are not directly influenced by $NH_3$, $H_2S$ and dust at levels and in combinations commonly encountered in the air inside enclosed houses at commercial swine production operations. (Rowe-East Central)

## 3335 - A11, B1, B2

### OPEN FLUMES SLASH CONFINEMENT COSTS,

B. Fleming
Beef, Vol. 12, No. 12, p. 8-9, August, 1976. 5 fig.

Descriptors: Design, Costs, Confinement pens, Cattle, Performance.
Identifiers: Floors, Open flumes.

A new floor design, the open flume, is being used by Gerald Frankl, a Sioux City Iowa consultant, in recent buildings and waste handling systems that he has designed for cattle feeders in the U.S., Canada, Iran, and South Africa. The design has 2 selling points: (1) It works at least as well as the traditional type of flume floor, and maybe a little better, and (2) The floor costs less than half as much as the enclosed system. Perhaps the first U.S. facility using the new design concept will be Dennis Ducomum farm, northeast of Larrabee, Iowa. A detailed description is given of this facility. Frankl estimates that in most Midwest locations, a feeder can build the floor, plus feedbunks, fences, waterers and plumbing for flushing, for about $25 to $35 per animal space. This figure does not include a lagoon or the building put over the floor. Other design advantages are: (1) There is less chance of cattle hurting themselves, and (2) the narrower building gives better ventilation on hot days and drier floors in damp weather. Frankl also discusses the possibilities of a confinement that will have a floor but no building. (Edwards-East Central)

## 3336 - A1, B1, B2, B3, B4, C2, D1, D3, E2, F1

### OHIO LIVESTOCK WASTE MANAGEMENT GUIDE,

Cooperative Extension Service, The Ohio State University, Columbus 43210
R. K. White
Ohio Livestock Waste Management Guide, Bulletin 604, Cooperative Extension Service, The Ohio State University, December, 1975, 32 p. 13 fig, 18 tab.

Descriptors: Farm wastes, Management, Livestock, Liquid wastes, Solid wastes, Design, Feedlots, Confinement pens, Waste storage, Waste treatment, Waste disposal, Poultry, Economics, Agricultural runoff, Safety, Pollution, Chemical properties.
Identifiers: Runoff control, Land application, Odor control.

This guide contains information which will help a livestock owner or operator make decisions in choosing and operating a livestock waste handling system which controls pollution. One important factor in determining the type of system is "how much manure is to be handled and what kind". Many types of systems are discussed, along with the cost and safety features of each. Ways to control rainwater runoff from feedlots are given. Other important factors included in this guide are: (1) land application rates, (2) odor control, (3) treatment units, (4) milking facility waste management, and (5) silage drainage. (Edwards-East Central)

## 3337 - B1, B2, B4, D3, E2

### EVALUATIONS OF BEEF FLUSHING GUTTER WASTE SYSTEMS IN MISSOURI, IOWA, AND MINNESOTA,

Agricultural Engineering Department, University of Minnesota, St. Paul 55108
J. A. Moore and R. M. George
Presented at the 1974 Annual Meeting, American Society of Agricultural Engineers, Oklahoma State University, Stillwater, June 23-26, 1974, 10 p. 2 fig, 2 tab, 3 ref.

Descriptors: Missouri, Iowa, Minnesota, Confinement pens, Cattle, Design, Irrigation.
Identifiers: Flushing, Cold confinement facilities, Floors, Land disposal, Floors.

In this study, 3 agricultural engineers observed and evaluated flushing beef systems. The report is based upon site visits and studies of more than 15 such units through the winter and spring of 1973-74. The 4 major components of the system are: (1) A building with sloping gutters or flumes running parallel to the bunk the entire length of the building, (2) the pump and recycle system which introduces the flushing water to the gutter, collects it at the other end and routes it to the storage and treatment facility, (3) A lagoon to store and treat the waste water after it has flushed the manure from the building and before it has again recycled, and (4) An irrigation system for sprinkling this liquid waste on adjacent agricultural land. All of the buildings observed were cold confinement facilities open to south. Construction type consisted of either pole or steel frame. Cattle floor width of 32-36 feet was found satisfactory. A 12-foot eave height seemed adequate. It was observed that the ridge opening should be at least 12 inches wide to avoid frosting shut. Ventilation openings on the back wall should be adjustable. The floor should be at least as rough as a broom finish to provide good footing for the animals. A floor slope of 1-inch per foot was found satisfactory. The number of gutters to be used and the benefits derived needs additional study. The design of the flushing system has to be based on the total manure distribution into the individual gutters. Narrow, shallow gutters need to be flushed more often. At the time of the engineers' visits, lagoons were not very active due to the cold temperature and no substantial evaluation was possible. Land spreading had not yet taken place; hence, it could not be evaluated. (Rowe-East Central)

## 3338 - A6, B1, B2, B5, D2, E2, F1

### REMOVE MANURE ODORS,

Anonymous
Hoard's Dairyman, Vol. 121, No. 3, p. 161, February 10, 1976.

Descriptors: Chemicals, Liquid wastes, Costs, Management, Ventilation.
Identifiers: Odor control, Biological compounds, Land disposal, Soil injection.

J. C. Converse, a University of Wisconsin agricultural engineer, says that some of the chemical and biological compounds used for controlling odors in liquid manure tanks are selling for $19 to $21 per pound. These compounds fall into the following categories: (1) Masking agents - those used to cover up offensive odors, (2) Counteractants - those which react with odors to make them inoffensive, and (3) Bacterial or enzyme compounds - those which act on the manure itself to lessen odor production. A study conducted about 5 years ago showed that most of these compounds are not effective and the ones that were effective were extremely expensive. Methods such as (1) soil injection, (2) plow down of manure immediately after spreading, (3) proper ventilation, and (4) proper climatic conditions for spreading should be tried before utilizing chemical and biological compounds. It is recommended that one should try a small amount of odor control chemicals before making a large order. (Edwards-East Central)

## 3339 - A6, A8, B2, B4, C2, D1, D2, D3, E1, E2

### COLLECTION AND DISPOSAL OF FARM WASTES,

Ministry of Agriculture, Northern Ireland
J. S. V. McAllister
Water Pollution Control, Vol. 69, No. 4, p. 425-429, 1970. 6 tab, 5 ref.

Descriptors: Farm wastes, Waste storage, Waste disposal, Slurries, Nutrients, Potassium, Odor, Drying, Incineration, Soil contamination.
Identifiers: Ireland, Land application, Odor control, Plant response, Wet combustion.

At present, practically all the slurry collected in the British Isles is disposed of by direct application to the land after a relatively short, 1 to 13 weeks, storage period. Some of the experience acquired in the handling and use of slurry in Northern Ireland is reviewed. Storage tanks in Northern Ireland are generally covered. Spreading is generally done by tanker. Vacuum tankers probably give the most uniform distribution, ensure more thorough agitation of the slurry in the storage tanks, and in wet weather can spread through pipelines. The unpleasant odors which occur during spreading can be minimized by the use of certain organic compounds, but at present these are not extensively used as they are expensive relative to the value of slurry. The manurial value of slurry is variable depending upon factors such as the livestock from which it is obtained, the duration and conditions of collection and storage, and the degree of dilution. Much experimental work is being undertaken to assess the manurial value of the plant nutrients in slurry. No reliable information is available on the long-term effects of regular applications of slurry on soil structure and sward growth under local conditions. A major problem which may arise from the intensive use of slurry as a manure will be a buildup in the concentration of nutrients in the soil and especially of potassium to an excessive level. Alternative methods of disposal as drying of excreta, incineration, and wet combustion are reviewed. (Solid Waste Information Retrieval System)

## 3340 - B2, B3, D1, E2

### HANDLE FREE STALL MANURE AS A SOLID WITH PICKET DAM STORAGE.

T. L. Loudon
Hoard's Dairyman, Vol. 121, No. 9, p. 587, 594, May 10, 1976. 3 fig, 1 tab.

Descriptors: Liquid wastes, Solid wastes, Water storage, Separation techniques.
Identifiers: Free stall manure, Picket dam, Land spreading.

There is now an alternative to handling manure as a liquid from free stall barns. Handling free stall manure as a solid with a new innovation — picket dam storage — allows the feedlot owner to be flexible in handling loads, to save time and trips when spreading, to cut hauling fuel costs, and to avoid 2 kinds of manure equipment. In such a system, manure can be moved to storage with a stacker, an underground piston pump which does not require added water during pumping, or a tractor push-off ramp. A picket-type structure with continuous verticle slots about three-fourths of an inch wide between standing planks holds manure solids back and allows liquids to drain from the storage facility. The verticle slats are made of treated 2 x 6's. Drainage should be moved from the manure storage to a holding pond through an open ditch or a pumping system involving a level controlled sewage pump in a sump. (Rowe-East Central)

## 3341 - B2, C2, D3

### SOME EFFECTS OF STOCKING FISH IN WASTE TREATMENT PONDS,

Fish and Aquaculture Research Station, Dor, Hof Hacarmel, Israel.
G. L. Schroeder
Water Research, Vol. 9, No. 5-6, p. 591-593, June, 1975. 2 tab, 9 ref.

Descriptors: Fish, Organic wastes, Dissolved oxygen, Chemical oxygen demand, Bacteria.
Identifiers: Waste treatment ponds, pH.

Five, 400 $m^2$, 1 m deep freshwater, earthen ponds were operated for 4 winter months with or without addition of organic wastes, and with or without fish. Organic waste in the form of liquid cow manure containing urine and feces was added to the ponds once every 2 weeks at rates up to 40 tons $ha^{-1}$. Observations showed that both DO and pH were significantly and consistently higher in the manured pond stocked with fish as compared with the manured, unstocked pond. Improved disinfection was indicated by the lower bacteria counts in the water of the manured pond with fish as compared to the manured, unstocked pond. Increased pH also improved the effectiveness of the pond as a nutrient trap. As pH increased, nitrogen was more readily lost to the atmosphere as $NH_3$ and multivalent ions, especially phosphorus, became less soluble and so were precipated more completely. These changes would be improvements to the operation of waste treatment ponds designed to provide an effluent low in BOD, nutrients, and bacteria. Bacteria concentrations were as much as 15 times lower in treatment ponds stocked with fish as compared with unstocked ponds. Lower bacteria concentrations, however, reduced the rate of loss of COD in the solids of the waste. (Rowe-East Central)

## 3342 - B3, C1, D1, F6

### POULTRY ENVIRONMENT SYSTEM MODEL FOR DRYING MANURE,

Associate Professor, Agricultural Engineering Department, University of Idaho.
J. E. Dixon, M. L. Esmay, and J. B. Gerrish
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, Lincoln, June 27-30, 1976, Paper No. 76-4039, 38 p. 4 fig, 2 tab, 24 ref.

Descriptors: Drying, Ventilation, Design, Poultry, Computer models, Moisture content.

The principle thrust of this study is the development of an analytical tool for maximizing pre-mechanical-drying. A computer simulation model for ventilation air pre-drying of poultry manure produced in a cage-type laying house has been developed. A 5000 bird egg production operation was used for validating the model. Experimental measurement of moisture content was made by taking samples of manure from the dropping boards just prior to removal of the manure from the laying house. The moisture content of these samples was determined by finding the difference in the weight of the water in the manure as voided and the weight of water in the manure just prior to removal from the laying house. The range of values for the two categories was 68.87 to 76.25 percent and 70.61 to 76.96 percent, respectively. The correlation coefficient of these data was 0.16. The data means and standard deviations were 73.09; 1.80 and 74.64; 2.07, respectively. The simulation model in its present form does not seem suitable for accurate estimates of in-house poultry manure drying using ventilating air. The basic concepts of the model do seem sound, however. Further work toward development of the simulation model and its verification would seem desirable. (Rowe-East Central)

### 3343 - A3, B1, C2, E2
### HOW MANURE APPLICATIONS AFFECT EROSION AND RUNOFF,

R. W. Gunther, W. D. Lembke, and J. K. Mitchell
Illinois Research, Vol. 17, No. 4, p. 11-12, Autumn, 1975, 1 fig, 1 tab.

Descriptors: Erosion, Agricultural runoff, Nitrates, Percolation, Soil investigations.
Identifiers: Land application.

A laboratory study was conducted to determine the effects of manure applications on runoff rates, erosion, and loss of nitrates. Three treatments were compared: 3/8 inch of waste (1.4 tons of solids per acre) applied to the soil surface; 3/4 inch of waste (2.8 tons of solids per acre); no manure, but 3/4 inch of water added to the soil. The water was applied to reduce the effect of the water in the animal waste when runoff comparisons were made. Waste applications decreased runoff by about 50 percent. However, the 3/4 inch application did not reduce runoff any more than the 3/8 inch application. Waste applications reduced the total loss of solids, both because the runoff was smaller, and because it contained a lower concentration of solids. Manure applications increased percolation through the soil. Much of the benefit derived from the liquid manure was due to the stabilization of the soil surface that resulted from the crust formed during drying. (Rowe-East Central)

### 3344 - A1, A11, A12, B1, C1, C2, C3, D1, D2, E2, E3, F1
### PROPERTIES RELATED TO UTILIZATION,

Agriculture Engineer, Agricultural Research Service, U. S. Department of Agriculture, College Park, Maryland.
G. W. Willson
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, Winter Meeting, December, 1972, p. 59-62.

Descriptors: Recycling, Fertilizers, Feeds, By-product recovery, Fuels, Economics, Safety.
Identifiers: Manure, Soil conditioners, Refeeding, Construction materials, Waste management, Efficacy.

Most known and suggested uses of animal manure fall into 1 of 4 categories: (1) Soil conditioners and fertilizers, (2) feed and food production, (3) fuel, (4) other uses. After the use is selected, the beneficial and detrimental properties of the manure can be identified and quantified. Most manures have been and probably will continue to be applied to crop lands as fertilizer. Manure is also useful for establishing cover on road banks and other construction sites. Manure may be used as potting soil; however, if the manure is fresh, some processing is necessary. Besides actually refeeding manure to animals, other methods of utilizing manure nutrients include: production of algae and water plants, raising fly larva in poultry manure as a protein supplement, culture of bacteria and fungi, and raising mushrooms on partially composted horse manure. Fuels may be recovered from manure simply in the form of dried manure or in production of gases and oils from manure. Manure may also be considered as a raw material for production of construction materials. Composted manure can be used as an organic carrier for chemical fertilizers. Dried compost can be used for animal bedding. The adoption and success of any of these practices will depend upon their efficacy, safety, and economics in the market place. In determining efficacy, consider: (1) concentration and uniformity of the desired ingredients, (2) availability of those ingredients and the rates at which they can be utilized, (3) public acceptability, (4) stability during storage and handling, (5) special requirements during the process and levels of use for the produce. In determining safety, the presence of extraneous materials, toxic materials, and/or of pathogenic organisms should be considered. Economic factors to consider are: potential for pollution, energy requirements, and possible influence on the animal production system. (Rowe-East Central)

### 3345 - A2, A8, B2, B4, B5, C2, E2
### STORED FEEDLOT RUNOFF MAY UNDERGO CHANGES,

Anonymous
Beef, Vol. 12, No. 6, p. 5, February, 1976.

Descriptors: Waste storage, Agricultural runoff, Nutrients, Salinity, Feedlots, Effluent.
Identifiers: Holding ponds.

Holding ponds are not considered as effluent treatment devices, but as storage which should be emptied as soon as possible. The effluent is most valuable when applied to a growing crop in need of moisture and nutrients. Because much of the feedlot runoff in Nebraska comes at a time outside the season for most annual crops or during a time when the soil profile is saturated, scientists studied the changes that can occur in the liquid when it is stored for later use. The effluent was found to be continually changing due to solids settling, microbial activity, evaporation, and dilution by direct rainfall. It was determined that effluent applications to the land should be adjusted according to nutrient accumulation and whether leaching is necessary to control salinity. (Merryman-East Central)

### 3346 - A2, A4, B2, B4, D1
### SOLUTION FOR SMALL-FARM RUNOFF,

Anonymous
Farm Journal, Vol. 100, No. 2, p. LK-2, February, 1976.

Descriptors: Agricultural runoff, Design, Settling basins, Nitrogen.
Identifiers: Swine, Infiltration channel, Solids removal.

A simple means of keeping hoglot runoff from streams, exemplified by Purdue University's Lynnwood Farm, is to construct a settling basin and infiltration channel. The cost is about $2 to $3 per hog capacity. This system is best adapted to a 200-700 hog operation. Lynnwood Farm is a 250-head Cargill open-front unit. It has a 16' x 16' x 30'' deep settling basin at the low end of the apron across the front of the building. This has been removing 60-76 percent of the solids and 54-75 percent of the total nitrogen from the runoff. Snaking to the rear is a grassed infiltration channel (or ditch or terrace) which ends with a small earthen retention facility. The infiltration channel should cover an area twice the size of the feedlot. At Lynnwood Farm, the total investment for the housing unit, feedlot and runoff control was $52 per head capacity. Exact design specifications for each individual feedlot owner's operation should be based on state regulations and local formulas. (Merryman-East Central)

### 3347 - B1
### SLUDGE SAMPLER,

Assistant professor, Agricultural Engineering Department, Institute of Food and Agricultural Sciences, University of Florida, Gainsville 32611.
R. A. Nordstedt and L. B. Baldwin
Agricultural Engineering, Vol. 56, No. 5, p. 47, May, 1975. 1 fig.

Descriptors: Equipment, Sampling, Lagoons, Anaerobic conditions, Design.
Identifiers: Sludge sampler.

A sludge sampler has been developed which collects samples at various depths in anaerobic animal waste lagoons. The procedure for using the sludge sampler is: (1) The sampler is lowered to the desired depth, aided by depth markings on a conduit. (2) The lever arm at the top of the sampler is actuated, removing the rubber stopper from the plastic cylinder and allowing sludge to flow into the sample chamber. (3) The lever arm is released and the spring in the sampling chamber pulls the rubber stopper back into the closed position, preventing mixing of the sample with sludge from other depths. (4) The sampler is removed from the lagoon. The bottom stopper is opened to transfer the sludge from the sampler to a bottle for transport to the laboratory. (Merryman-East Central)

### 3348 - A2, B1, B2, B3, B4, C2, D1, D2, D3, E2, E3
### EVERYTHING GOES ROUND AND ROUND AT KAPLAN'S FEEDLOT,

Editor, Beef
P. D. Andre
Beef, Vol. 12, No. 9, p. 4-6, May, 1976. 4 fig.

Descriptors: Recycling, Separation techniques, Confinement pens, Feedlots, Lagoons, Algae, Agricultural runoff, Irrigation.
Identifiers: Refeeding, Nile Perch, Packing plant wastes, Land spreading, Paunch manure.

In 1963, Don Kaplan contracted with Corral Industries, Inc., Phoenix, Arizona, to build 6 quarter-mile long slatted floor barns, along with a manure collection, separation, and recycling system. The confinement barns, alleyways, and drive lanes cover 18 acres. The barns are roofed and all open areas are hard surfaced so that every drop of runoff can be collected. The waste materials which collect under the barns are scraped on a time clock system every 2 hours and then flow by gravity to a nearby collection pit. Materials from the pit are put through a vibration separator and the solids are removed and stockpiled for incorporation back into the ration. The liquid flows to a nearby lagoon system. The lagoons are worked phosphate pits left over from a former phosphate mining operation. Connecting lines allow the water to flow from one lagoon to another. As the material moves through the series of lagoons, the nutrients are utilized by algae. Nile Perch have been placed in the last lagoon to eat the algae. Kaplan has contracted with a commercial fisherman who will seine out the fish, except for some brood stock. This operator will remove the filets and sell them and the unusable portions will be returned to Kaplan for conversion into fish meal to be used in his cattle rations. By using the algae-eating fish, the lagoon water becomes potable after chlorination and is pumped back to be reused in the packing plant and feedyard. Some water is also used for irrigating crops. Other wastes that Kaplan incorporates into his cattle feeding rations are blood from the packing plant and meat and bone meal made from bones and other packing plant residues. Paunch manure is hauled and spread on nearby fields. Among Kaplan's future plans is the construction of a methane production plant for converting wastes to methane. A by-product of this process will be dry ice. (Rowe-East Central)

### 3349 - B2, B4, B5, C1, C2, D3, E2
### THE INFLUENCE OF THE LAGOON STORAGE OF LIQUID MANURE ON ITS VOLUME AND COMPOSITION,

F. Schulz
Wasserwirtschaft-Wassertechnik, Vol. 22, No. 6, p. 190-191, June, 1972. 2 fig, 11 ref.

Descriptors: Lagoons, Waste storage, Physical properties, Chemical properties, Liquid wastes, Biochemical oxygen demand, Nitrogen, Potassium, Phosphorus, Waste treatment.
Identifiers: Land disposal, Purification, Irrigation.

A model experiment on the efficiency of the lagoon storage of liquid manure is described. The rate of volume reduction of cattle manure in unsealed lagoon in pervious soil was 1,055 mm per year or 2.9 mm per day due to the combined effect of leakage and evaporation, while the corresponding value for sealed lagoon was 220 mm per year. Investigations of the liquid component revealed reductions of about 62, 48, and 54 percent in the BOD, the total nitrogen, and the potassium contents, respectively. The reduction of the total organic content in unsealed lagoon was not significant. The results indicate that storing liquid manure in lagoons is incapable of producing satisfactory purification, and that the liquid component must be disposed of on farmland due to its high organic and mineral contents. (Text in German) (Solid Waste Information Retrieval System)

## 3350 - B1, B2, B3, B5, C1, C2, D1, D2, D3, E2, E3, F1,
### FINISHING CATTLE IN THE SOUTHEAST,

Feedstuffs, Southeastern Correspondent
R. H. Brown
Feedstuffs, Vol. 48, No. 33, p. 20-22, August 16, 1976. 7 fig.

Descriptors: Recycling, Lagoons, Biological treatment, Physical treatment, Chemical treatment, Algae, Chlorination, Fuels, Methane, Carbon dioxide, Byproducts, Separation techniques.
Identifiers: Refeeding, Tilapia, Dry ice.

Kaplan Industries' Florida feedlot is no ordinary cattle operation. Between its integrated feeding-packing business and a sophisticated waste handling system, the company hopes to prove that it is possible to finish cattle in the semi-tropical region of the United States. Kaplan's feedlot has been built on an abandoned strip of land where phosphate was once mined. The yard is designed to benefit from Florida's bountiful rainfall. In addition to the rainfall, 350,000 gallons of water from the packing plant are incorporated daily into the system. The water is handled in an anaerobic-aerobic lagoon system which utilizes algae as part of the biological treatment process. In the final stages, the water goes by gravity from the lagoons to shallow pits where more surface is exposed to oxygen and sunshine and aerobic bacteria do their work. The water is then chlorinated and reused as drinking water for cattle. Any remaining water is sprayed over 100 acres of crop land. In 2 of the lagoons, tilapia are used to harvest the algae. Commercial fishermen then pay 13 cents a pound to harvest the tilapia. The fish are filleted, and the heads and bones are returned to Kaplan's feedlot where they are rendered into fish meal and fed to the cattle. The feces and urine which are generated by the cattle go through a separation process. The recaptured solids are refed to the cattle. The liquids are allowed to ferment, giving off methane and carbon dioxide. The first may be used as fuel to run the meat packing plant, and supply the needs of the city of Bartow. The carbon dioxide may be used to make dry ice. The remaining sludge and dirty water are centrifuged. The solids are refed to the cattle. The dirty water is fed into the lagoon system. (Rowe- East Central)

## 3351 - A11, B3, C1, C2, C3, D3, E3
### FERMENTATION, UTILIZATION AND PALATABILITY OF BROILER LITTER ENSILED AT DIFFERENT MOISTURE LEVELS,

L. F. Caswell, J. P. Fontenot, and K. E. Webb, Jr.
Livestock Research Report, Research Division Report 163, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, July, 1975, p. 96-111. 11 tab.

Descriptors: Litters, Fermentation, Feeds, Sheep, Cattle, Moisture content, Performance, Chemical properties, Biological properties.
Identifiers: Refeeding, Ensiling, Palatability.

Experiments were conducted to study the fermentation characteristics of large masses of litter ensiled at 22 and 40 percent moisture and to assess the digestibility, nitrogen utilization and palatability of rations containing these ensiled materials. Wood shaving based broiler litter was obtained from a commercial broiler house, dried for approximately 36 hours, and ground in a hammermill. A 1200 lb. batch, containing 22.3 percent moisture (no water added), was thoroughly mixed and augered into each of 2 silos. Another 1200 lb. batch was mixed with tap water to achieve 40 percent moisture content. This batch was also placed in 2 separate silos. One 22 percent moisture silo and one 40 percent moisture silo were opened after 159 days of ensiling. The litters from these silos were fed concurrently in a metabolism trial with sheep and in the first of 2 palatability trials with cattle. The remaining 2 silos were opened for feeding at the beginning of the second palatability trial, 212 days after ensiling. Each silo was sampled daily at feeding, and the samples periodically were composited according to type of ensiled material and frozen for subsequent chemical analysis. Samples for microbiological determinations were obtained from each silo upon opening and on the last day of feeding from that silo. Study data indicated that active fermentation will occur in litter ensiled at a moisture level of 40 percent. Furthermore, utilization of nitrogen from a ration supplemented with 40 percent moisture litter silage was comparable to that of a conventional ration supplemented with soybean meal when fed to sheep. Although intake by cattle of a ration containing 40 percent moisture litter silage was not satisfactory, this response may have been partially due to the short period of time over which the product was fed. A longer feeding trial is presently being conducted with cattle in an attempt to more accurately evaluate the palatability of litter silage containing 40 percent moisture and to elucidate the cause of depressed intake. (Edwards-East Central)

## 3352 - A11, B3, C1, C2, D1, D2, E3
### DIGESTIBILITY OF UNTREATED AND SODIUM HYDROXIDE TREATED STEER FECAL WASTE,

D. M. Lucas, J. P. Fontenot, and K. E. Webb, Jr.
Livestock Research Report, Research Division Report 163, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, July, 1975, p. 115-122. 5 tab.

Descriptors: Sheep, Feeds, Cattle, Waste treatment, Drying.
Identifiers: Digestibility, Refeeding, Dried fecal wastes, Sodium hydroxide.

A study was conducted to determine chemical composition and digestibility of untreated and chemically treated heat-dried fecal waste from yearling steers fed rations containing either 50 percent roughage ration or 10 percent roughage ration. Each feeding trial consisted of a 10-day preliminary period which was followed by a 14-day waste collection period. On odd days untreated feces were placed in screen wire trays and dried in a forced draft oven at 248 degrees F for 24 hours, while on even days, feces were treated by adding 3 percent sodium hydroxide, by weight, and dried. These processed wastes were later refed in a randomized block design in which 6 lambs received each of the following treatments: (1) basal, (2) 75 percent basal; 25 percent untreated low roughage fecal waste, (3) 75 percent basal; 25 percent sodium hydroxide treated low roughage fecal waste, (4) 75 percent basal; 25 percent untreated high roughage fecal waste, (5) 75 percent basal; 25 percent sodium hydroxide treated high roughage fecal waste. The basal ration contained 30 percent roughage. Crude protein content was 20.69, 17.03, 18.04, and 14.89 percent, dry basis for oven-dried untreated low roughage, treated low roughage, untreated high roughage, and treated high roughage fecal waste, respectively. Treating wet fecal waste with 3 percent sodium hydroxide appeared to cause some nitrogen loss. A similar reduction in crude protein content of sodium hydroxide treated fecal waste occurred for waste from steers fed the high and low roughage rations. Crude fiber content of fecal waste from steers fed a low roughage ration was less than that for fecal waste from steers fed a high roughage ration, and crude fiber content of the fecal waste was reduced by alkali treatment. Apparent dry matter digestibility was decreased by substitution of all types of fecal waste for 25 percent of the basal ration. (Edwards-East Central)

## 3353 - A11, B1, C2, C3, E4
### PROTEIN QUALITY OF RUMEN BACTERIAL PREPARATIONS FROM CATTLE FED RATIONS OF DIFFERENT ROUGHAGE CONTENT,

R. B. Keyser, K. E. Webb, Jr., and J. P. Fontenot.
Livestock Research Report, Research Division Report 163, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, July 1975, p. 123-127, 3 tab.

Descriptors: Proteins, Bacteria, Cattle, Nitrogen, Amino acid, Rations.
Identifiers: Rumen bacteria, Rats, Roughage content.

A study was conducted to determine the protein quality of rumen bacteria from steers fed rations differing in roughage to concentrate ratio. Rumen fluid was collected from 2 steers fed on an 84 percent concentrate ration and from 2 steers fed a 79 percent roughage ration via rumen cannulae. Bacteria were harvested from the supernate by centrifuging at 27,000 x g in a continuous flow system and feed particles and protozoa were removed from the fluid by centrifuging at 1,000 x g. After the bacteria were frozen, lyophilized and ground, they were analyzed for amino acid composition and for total nitrogen content. Bacteria from the roughage fed and concentrate fed steers contained 53.55 percent amino acids on a dry basis. The correlation in amino acid composition between sources for both concentrations and molar ration was .997 ± .020 ($p < .01$). Both total nitrogen and amino nitrogen were very similar between the bacterial sources. Amino nitrogen as a percent of total nitrogen was 76.5 percent for the roughage bacteria and 76.1 percent for the concentrate bacteria. The bacterial proteins were found to contain approximately 13 percent nitrogen for both protein sources. Seventy-five Sprague-Dawley male weanling rats were fed a standard diet for 5 day period. One group was fasted for 24 hours and then sacrificed while the remaining 4 groups were placed in metabolism cages and fed ad libitum purified diets containing one of 4 different protein sources which were: (1) bacteria from roughage fed steers, (2) bacteria from concentrate fed steers, (3) soy protein and (4) zein protein. They were fed and weighed daily for 10 days. At the end of the 10 days, all rats were fasted for 24 hours and sacrificed. The following conclusions were drawn: (1) rats consuming both the soy and concentrate bacteria had the highest nitrogen intakes, (2) rats consuming the zein diet had the lowest nitrogen intake, (3) daily gain was highest for rats consuming the diet with concentrate bacteria and lowest for those fed the diet supplemented with zein, (4) nitrogen retention was greatest for rats fed the diet supplemented with the concentrate bacteria and lowest for those fed the diet supplemented with zein. (Edwards-East Central)

## 3354 - A11, B3, C2, E3
### PERFORMANCE AND LIVER COPPER LEVELS OF BEEF HEIFERS FED BROILER LITTER.

K. E. Webb, Jr., J. P. Fontenot and W. H. McClure
Livestock Research Report, Research Division Report 163, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, July, 1975. p. 128-131.

Descriptors: Performance, Litters, Cattle, Feeds, Copper.
Identifiers: Refeeding, Liver, Toxicity.

Although broiler litter has been shown to have substantial nutritive value, the Food and Drug Administration does not sanction the use of broiler litter or any other animal waste as a feed ingredient. In December, 1972, a study was begun at the Shenandoah Valley Research Station to evaluate the effect of long-term feeding of broiler litter on the performance of cows and upon the accumulation of copper in the liver of cows. This study will continue 5 to 7 years longer. Forty-two weanling heifers were allotted at random by weight and breeding to 3 lots. During the winter of 1972-73, lot 1 animals were fed 8.5 lb of mixed hay, 3 lb of ear corn, and 1 lb of a complex urea supplement per head per day. Animals in lots 2 and 3 were self-fed a mixture of 50 percent broiler litter and 50 percent ear corn. Copper was added in lot 3 to supply an additional 100 ppm copper. During the second and third winters, the heifers were fed the following rations: Lot 1 - Hay; Lot 2 - 75 percent broiler litter, 25 percent ground ear corn; and Lot 3 - 75 percent broiler litter, 25 percent ear corn, and 17 ppm supplemental copper. In order to minimize grazing, the heifers were kept in small lots. Weight and food consumption was recorded at 28-day intervals. Each fall before the cattle were put on the wintering feed and each spring before they were turned out to pasture, liver samples were obtained by biopsy. It was found that (1) ration consumption by heifers was quite good, (2) calving performance for the first calf crop was good, (3) the numbers of calves born showed no detrimental effect of feeding broiler litter or broiler litter plus additional copper. In fact, more calves were born in the groups fed litter. This experiment is still in progress and to date no detrimental effects of feeding broiler litter as a wintering feed have been observed in the animals studied. (Edwards-East Central)

### 3355 - A11, C1, C2, D3, E3
### FERMENTATION, UTILIZATION AND PALATABILITY OF BROILER LITTER ENSILED WITH HIGH MOISTURE CORN GRAIN,

L. F. Caswell, J. P. Fontenot, and K. E. Webb, Jr.
Livestock Research Report, Research Division Report 163, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, July, 1975, p. 132-150. 13 tab.

Descriptors: Fermentation, Litters, Sheep, Cattle, Performance, Corn, Rations, Moisture content.
Identifiers: Refeeding, Ensiling, Palatability.

This study was conducted to study the fermentation characteristics of an ensiled mixture of broiler litter and high moisture corn grain and to assess the digestibility nitrogen, utilization, and palatability of rations containing the ensiled mixture. Corn grain containing 25 percent moisture was harvested and ensiled by weight in a 2 to 1 ration with wood shaving based broiler litter containing 19 percent moisture and 37 percent crude protein. Both were then ground and placed in 6 silos for the corn and 2 for the corn-litter mixture. After 80 days, 3 of the corn and 1 of the corn litter silos were opened and fed in a metabolism trial with sheep and in the first of 2 palatability trials with cattle. The remaining 4 silos were opened for feeding at the beginning of the second palatability trial. Study results indicated that litter fermented with high moisture corn grain appears to be a reasonable approach to utilization of the waste as well as a feasible system of fattening cattle since this material was satisfactorily metabolized when fed to sheep and was readily accepted when offered to beef steers. Additional research is needed to evaluate the utilization and palatability of mixtures containing a greater proportion of litter. This would mean that a greater quantity of the waste would be disposed of, and the cost of feeding the mixture may be lowered. Also, fermented mixtures should be fed experimentally in long term trials in which performance is measured. (Edwards-East Central)

### 3356 - A11, B1, C1, C2, E3
### NUTRITIVE VALUE OF SWINE FECES FOR SWINE,

M. R. Holland, E. T. Kornegay, and J. D. Hedges
Livestock Research Report, Research Division Report 163, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, July, 1975, p. 202-207. 6 tab.

Descriptors: Energy, Rations, Physical properties, Chemical properties, Nutrients
Identifiers: Refeeding, Swine feces, Digestibility, Minerals, Retention.

The objectives of this study were to characterize wet and dried swine feces as to their proximate energy and mineral composition and to determine digestibilities and retention values for the proximate energy and mineral components. Forty-eight crossbred gilts, averaging 275 lbs each, were fed swine feces collected from finishing hogs. One trial used unprocessed feces with test rations being: (1) basal (15 percent crude protein fortified corn-soybean meal), (2) basal substituted with 22.90 percent swine feces, and (3) basal substituted with 33.83 percent swine feces. In the second trial, dried feces were substituted for the 15 percent basal corn-soybean ration previously used at levels of 20.50 percent and 40.71 percent of the dry matter of the basal rations. Fecal content of crude fiber, ether extract, crude protein, magnesium, copper and zinc were found to increase as the amount of feces substituted for the basal ration was increased. The fecal content of ash, NFE, calcium, phosphorus, and potassium tended to be constant. Urinary phosphorus was the only urinary component that was significantly increased when feces were substituted for the basal ration. The amount of feces excreted increased as the amount of feces substituted for the basal ration was increased, with no difference in urinary output. Swine feces were found to be of less nutritive value than a basal corn-soybean meal ration, but nutrients were available. Digestibilities and retention values were simialr between the wet and dry trials. (Edwards-East Central)

### 3357 - A5, B2, B4, C2, C3, D3
### EFFECT OF ANAEROBIC SWINE LAGOONS ON GROUND WATER QUALITY,

Department of Agronomy, Virginia Polytechnic Institute and State University, Blacksburg 24061
T. G. Ciravolo, D. L. Hallock, H. R. Thomas, E. R. Collins, Jr., D. C. Martens, and E. T. Kornegay
Livestock Research Report, Research Division Report 163, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, July, 1975, p. 208-211. 1 tab.

Descriptors: Lagoons, Anaerobic conditions, Sampling, Virginia, Nutrients.
Identifiers: Groundwater pollution, Swine, Fecal coliforms.

Anaerobic lagoons have become increasingly popular in the Coastal Region of Virginia because of their ease in construction and their inexpensive maintenance. In an effort to study the effects of such lagoons on groundwater quality, tests were conducted at 3 different lagoons. The lagoons were located at (1) Tidewater Research and Continuing Education Center (TRACEC), (2) The Virginia Swine Evaluation Station (VSES), and at a private farm in Suffolk. The lagoons were located on high water table soils ranging in texture from sandy loam to fine sandy loam. Wells to be sampled were located at various depths and distances around the lagoons. Bimonthly groundwater samples were taken from September, 1974, through January, 1975, to determine $NO_3$-N, $NH_4$-N, C1, soluble orthophosphates, Cu, Zn and fecal coliforms. Results of the tests showed that USPHS Standards for drinking water were not exceeded in any well except for one well at the private farm in Suffolk which had over 250 ppm C1. Future work is being planned which will enable bimonthly sampling of groundwater. Soil samples will also be collected to determine the loading capacity of the soil and the loading effect of seepage from the lagoons on these soils. (Edwards-East Central)

### 3358 - A8, C2, E2
### EFFECT ON SOIL AND PLANT MINERAL LEVELS FOLLOWING THREE ANNUAL APPLICATIONS OF SWINE MANURES OF DIFFERENT COPPER CONTENTS,

Department of Animal Science, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
E. T. Kornegay, J. D. Hedges, D. C. Martens, and C. Y. Kramer
Livestock Research Report, Research Division Report 163, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, July, 1975, p. 212-215. 2 tab.

Descriptors: Plant response, Fertilizers, Nutrients, Copper, Zinc, Magnesium, Phosphorus.
Identifiers: Application rates.

A third year of study was conducted on plots planted to corn in order to evaluate the effect of high copper manures on corn growth and grain composition. The experimental treatments were: (1) no manure, (2) control manure applied and (3) high copper manure applied. There was an accumulation of copper in the surface layer of soil when high copper manure was applied, but the level after 3 annual applications was well within a safe range for good crop production. When both types of manure were applied, there continued to be an increase in zinc, magnesium and phosphorus levels of the soil. However, these increases were not considered harmful. No increase was found in the copper concentration of the grain, and only a small increase was found in the copper content of the corn plant (ear leaf) when high copper manure was applied at a rate of about 26 ton / acre (24 percent dry matter) annually. The phosphorus and zinc content of the ear leaf and the grain were increased slightly when both types of manure were applied. (Merryman-East Central)

### 3359 - A3, A8, B2, C2, D3, E2
### EFFECTS OF SWINE LAGOON EFFLUENT DISPOSAL ON SOIL-PLANT RUNOFF QUALITY,

Department of Agricultural Engineering, Virginia Polytechnic Institute and State University, Blacksburg 24061
E. R. Collins, Jr., D. C. Martens, and E. T. Kornegay
Livestock Research Report, Research Division Report 163, Virginia Polytechnic Institute and State University, Blacksburg, 24061, July, 1975, p. 216-220. 3 tab.

Descriptors: Lagoons, Agricultural runoff, Liquid wastes, Biological treatment, Confinement pens, Chemical properties.
Identifiers: Land disposal, Swine wastes, Plant response.

The most reasonable waste management alternative for swine producers is to design and manage systems so that swine wastes can be collected and applied to land in a controlled manner. To this end, many farmers have begun collecting manure in pits beneath slatted floor housing, and draining or flushing liquid manure into anaerobic lagoons. This study was conducted to (1) compare 2 systems of biological treatment for swine wastes in Virginia, (2) monitor wastes from 2 confinement swine production facilities and effluent from their companion waste treatment systems to determine the degree of biological treatment afforded and the fate of mineral feed constituents, and (3) measure effects of application of lagoon effluent from the above systems on runoff water quality and pollutant accumulation in soil-plant disposal areas. Two enclosed slatted-floor production pens have been in operation since November, 1974. Each pen contains equivalent live weight units of feeder pigs. Pits are flushed into separate sealed concrete treatment tanks. The first tank is operated as an anaerobic lagoon while the other is aerated mechanically at a rate equivalent to twice its estimated daily BOD5. In order to distribute treatment tank effluent on soil-plant disposal plots, a permanent waste irrigation system has been installed. Since November, 1974, samples of waste influent and treatment tank effluent have been taken monthly. $NO_2$/$NO_3$ -N, $NH_4$ -N, TKN, C1, total and dissolved volatile solids, and total and dissolved ash determinations have been made but data has not been analyzed. Tests will be continued so that sufficient data can be obtained in order to support meaningful conclusions. (Edwards-East Central)

### 3360 - A12, B1
### EVALUATION OF DIETARY SALT LEVELS FOR SWINE. 1. EFFECT ON GAIN, WATER CONSUMPTION AND EFFICIENCY OF FEED CONVERSION,

King Feed Co., Blandinsville, Illinois 61420
I. Hagsten and T. W. Perry
Journal of Animal Science, Vol. 42, No. 5, p. 1187-1190,

May, 1976. 4 tab, 7 ref.

Descriptors: Performance, Diets, Salts.
Identifiers: Swine, Gain Water consumption, Feed conversion.

An attempt was made to establish the salt requirement for maximum rate of gain for growing swine. Four experiments utilizing 73 crossbred barrows were designed. Conventional corn-soybean meal diets with varying amounts of supplemental salt and deionized water were offered ad libitum. The salt levels studied ranged from .06 to .48 percent total dietary salt equivalent. Feed conversion and average daily gains were inferior below .20 percent total dietary salt equivalent. The pigs with deficient salt intakes consumed less water. Salt intake had a positive significant correlation with average daily gain and between 15 and 48 percent of the variability in average daily gain was accounted for by the levels of salt added to the diets. Under practical swine feeding situations where the base level of salt content in feed and water is unknown, supplementation with a maximum of .20 percent salt is a safe recommendation. (Rowe-East Central)

## 3361 - A2, A5, C2

### EVALUATION OF NITRATE CONTENT OF GROUND WATER IN HALL COUNTY, NEBRASKA,

Division of Land Pollution Control, Illinois Environmental Protection Agency, Springfield, Illinois 62702
R. Piskin
Groundwater, Vol. 11, No. 6, p. 4-13, November-December, 1973. 4 fig, 8 tab, 9 ref.

Descriptors: Groundwater pollution, Nitrates, Water pollution sources, Nebraska, Sampling, Fertilizers, Feedlots.
Identifiers: Hydrogeologic factors, Septic-tank effluents.

Nitrate concentrations in the groundwater of Hall County, Nebraska, were evaluated in relation to soil types, streams, hydrogeologic factors, and cultural practices. These concentrations were correlated with selected physical and chemical parameters of wells, and groundwater, respectively. In the summer of 1971, 161 water samples from wells were collected and analyzed. Nitrate concentrations of less than 10 mg /1 were assumed to occur naturally in the groundwater of Hall County. Nitrate enrichment of groundwater was found to be related to conditions existing at or near the wells. High nitrate concentrations were associated with high hydraulic conductivity. Seepage from the Wood River, into which effluents from several sewage-disposal plants are discharged, elevated the nitrate content of groundwater adjacent to the stream. Fertilizers were not found to be contributing to groundwater pollution in Hall County. Seepage from septic-tank effluents and feedlot runoff was found to be a major source of nitrate in groundwater in highly localized rural and urban areas of Hall County. About 54 percent of the irrigation wells containing 10 mg /1 and greater nitrate concentrations were associated with domestic wells. Nitrate in groundwater decreased with the increasing well depth and well penetration below the water table. Nitrate in groundwater was stratified where the concentration was high. Highest concentrations were at or near the water table in the immediate area of sampled wells which were close to a potential nitrate source. (Rowe-East Central)

## 3362 - A2, A3, A4, A5, B1, C2, C3, F4

### EFFECTS OF AGRICULTURE ON WATER QUALITY,

Chief Agricultural and Marine Pollution Control Branch, Federal Water Pollution Control Administration, Q.S.D.I.
H. Bernard
Relationship of Agriculture to Soil and Water Pollution, Cornell University Conference on Agricultural Waste Management, Rochester, New York, p. 6-10. 1 tab, 3 ref.

Descriptors: Water pollution, Groundwater pollution, Agriculture, Sediment, Pesticides, Animal wastes, Fertilizers, Nutrients, Salts, Eutrophication, Fish kills, Algal blooms, Nitrates.

Pollution problems arising from sediment, pesticides, animal wastes, nutrient runoff from fertilizer use, and inorganic salt pollution from irrigation practices are discussed. About one billion tons of sediment reach the contiguous rivers annually from agricultural sources due to erosion. Sediment deposits in stream channels reduce their capacity to convey water and sometimes seriously impair drainage of adjacent lands. Salts and nutrients adsorbed on sediment particles dissolve in water and contribute to eutrophication of surface waters. Pesticide residues carried by sediment may be released in the stream environment to be taken up and concentrated by various aquatic organisms. The oxidation of organic pollutants is hindered by sediment in streams. Feedlot wastes are also serious pollution contributors. Feedlot runoff has caused serious fish kills. Increases in nitrates in ground waters have been traced to the animal feeding industry. Nitrogen and phosphorous in manures may be present in runoff, and may add to the fertilization of lakes and ponds, increasing the rate of eutrophication. Pathogenic organisms may also be present in such runoff. Another large problem is nutrient runoff associated with fertilizer use. Fish kills algal blooms, and foul odors emanating from surface waters may be associated with such runoff. Groundwater contamination can also be traced to fertilizer use. Salts, which are present in soils and geologic materials of arid regions as a result of mineralogical weathering processes, find their way into water sources through leaching and runoff. To maintain a salt balance in the soil that will support crop growth, the total amount of salt applied in the irrigation water must be leached out in the drainage water. Since the volume of drainage water is much less than the irrigation water applied, the salt content in the drainage is much greater. The distribution and concentration of pesticides through the water cycle and food cycle to the consumer has also become a problem. (Ott-East Central)

## 3363 - A7, A11, B2, C3, D3

### AEROSOL DISPERSION OF PATHOGENS FROM A MODEL OXIDATION DITCH,

University of Minnesota
L. A. Will, S. L. Diesch, B. S. Pomeroy, S. L. Spier, P. R. Goodrich
Livestock Environment Affects Production, Reproduction, and Health, Proceedings of the International Livestock Environment Symposium, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, April 17-19, p. 176-181.

Descriptors: Aerosols, Pathogenic bacteria, Salmonella, Model studies, Sampling, Slurries.
Identifiers: Oxidation ditch, Animal health, Leptospira pomona.

With the knowledge that enteric (salmonella) and urinary tract (leptospires) pathogens survive manure treatment in a model oxidation ditch, researchers endeavored to learn whether these microorganisms become aerosolized and transmit disease to laboratory animals housed in confinement pens above the ditch. A 1:10 scale laboratory model of an existing field (Pasveer) oxidation ditch was constructed at Rosemount Experiment Station, University of Minnesota. Virulent Salmonella typhimurium and Leptospira sero-type pomona MLS bacteria were inoculated into the manure slurry of the model system during separate experiments. The slurry and the ambient air of the model system were sampled and the laboratory animals were examined for evidence of infection with either pathogen. L. pomona MLS survived the minimal six-week period; whereas, S. typhimurium was re-inoculated into the slurry to maintain potentially health hazardous microbial conditions in the lab-animal convenient housing unit. Exposed hamsters remained culturally and serologically negative to leptospiral infection. Turkey poults occasionally became infected with S. typhimurium. Leptospiral microbioaerosols were detected only once. S. typhimurium was isolated more commonly. The expressions of leptospiral virulence may have been altered by the slurry environment. Indicator coliform microbioaerosol counts were below those of compared dairy barn tests. (Rowe-East Central)

## 3364 - A7, A11, A12, B2, C3, D3

### MICROBIAL AEROSOL MONITORING OF A BEEF HOUSING OXIDATION DITCH,

Assistant Professor, Agricultural Engineering Department, University of Minnesota, St. Paul, 55101
P. R. Goodrich, S. L. Spier, S. L. Diesch, and L. A. Will.
Livestock Environment Affects Production, Reproduction, and Health, Proceedings of the International Livestock Environment Symposium, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, April 17-19, 1974. p. 182-188. 2 fig, 2 tab, 2 ref.

Descriptors: Aerosols, Public health, Sampling, Bacteria, Aeration.
Identifiers: Oxidation ditch, Animal health.

The purpose of this study was to monitor the bioaerosol production from an operational field oxidation ditch (Pasveer), aerated by a rotor, and to assess the public health hazard in relation to bacteria produced by the waste treatment facility. An air sampling program was developed after careful research. The air environment within the housing unit was found to harbor a rich bioaerosol. Counts approximating 100 to 200 total colony forming units per liter of air sampled were observed routinely in the year sampling period. It was evident, however, that these high levels were caused by the animal population and not by the oxidation ditch system. Indicator fecal bacterial aerosols also were higher when the animals were present. Therefore, the oxidation ditch again was not deemed to be the source of the bacterial aerosols. The magnitude of indicator fecal microorganisms was low when compared with the level of total aerosol microorganisms found. It was concluded that the wet floor environment in the buildings suppressed aerosol formation. During cleaning periods when the floor was left dry, usually high potentially hazardous levels of aerosols existed within the barns. During normal operations, however, the oxidation ditch treatment system did not create a health hazard for either man or animals. (Rowe-East Central)

## 3365 - A6, A7, A11, B2, B4, C2

### SOME CONSTITUENTS IN THE ATMOSPHERE OF A HOUSED SWINE UNIT,

Microbiologist, U.S. Department of Agriculture.
L. F. Elliott, J. A. DeShazer, E. R. Peo, Jr., T. A. Travis, and T. M. McCalla
Livestock Environment Affects Production, Reproduction, and Health, Proceedings of the International Livestock Environment Symposium, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, April 17-19, 1974, p. 189-194. 1 fig, 5 tab, 13 ref.

Descriptors: Air pollution, Confinement pens, Odor, Waste storage, Anaerobic conditions, Ventilation, Gases.
Identifiers: Swine, Animal health.

A study was conducted in a completely enclosed swine growing-finishing building at the University of Nebraska Field Laboratory, Mead. The portion of the building that was used for the study was equipped with an anaerobic manure-storage pit under a completely slotted floor. The unit was divided into 16 pens, each containing 8 animals. During the study, the building was ventilated naturally because of faulty fans. Aerial $CO_2$, $NH_3$-N, non-$NH_3$-N, and $H_2S$ were measured weekly during the study and intensively during anaerobic pit pumpout. Aerial measurements were taken 1 inch beneath the slotted floor, 1 foot above the floor (swine level) and 4 feet above the floor. No $CO_2$ levels were found that could be considered deleterious to animal health. $CO_2$ was higher in the east end than the west end due to air currents.

Significantly higher quantities of non-$NH_3$-N were present in the atmosphere. The non-$NH_3$-N fraction partially represented amine and /or amine-related compounds which were very odorous. Ambient levels of $H_2S$ in the unit ranged from 0.9 to 0.2 ppm. During pumpout, $H_2S$ varied considerably, with levels ranging from undetectable to 43.4 ppm and averaging 2.7 ppm. (Rowe-East Central)

### 3366 - A7, A12, B1, C2
### AIR POLLUTION AND HUMAN WORK CAPACITY,

Director, Max-Planck-Institute, Bad Kreuznach, Germany
G. Preuschen
Livestock Environment Affects Production, Reproduction, and Health, Proceedings of the International Livestock Environment Symposium, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, April 17-19, 1974, p. 195-198. 2 tab, 5 ref.

Descriptors: Air pollution, Confinement pens, Odor, Respiration.
Identifiers: Health.

There are 4 reasons why working capacity in animal production facilities may be reduced: (1) More time must be spent in animal houses due to farm specialization, (2) The same person performs barn work day after day and the change from barn work to open air work is rather seldom. (3) Due to specialization only one kind of stock is kept in large numbers and this leads to an increasing influence of negative environmental factors on barn workers. (4) Modern animal houses differ essentially from traditional houses in 2 ways: (a) No bedding is used, and (b) More animals are confined to a relatively small housing area. Experiments performed on the influence of less annoying air from animal houses on human respiration led to the following conclusions: (1) Bad smell from animal houses is not only unpleasant but health damaging. Irritation of bronchias (coughing) and dizziness are the result. (2) Subjects with a sensible respiratory system tend to shortness of breath and will become easily tired. (3) Existing bronchial allergies may be intensified so that persons smelling emissions from animal houses become unable to work because of asthma. (Rowe-East Central)

### 3367 - A7, A11, B1, C2
### EFFECTS OF AERIAL AMMONIA, HYDROGEN SULFIDE, AND SWINE HOUSE DUST, ALONE AND COMBINED, ON SWINE HEALTH AND PERFORMANCE,

Assistant Professor, Animal Science Department, University of Illinois at Urbana-Champaign, Urbana 61801
S. E. Curtis, A. H. Jensen, J. Simon, and D. L. Day
Livestock Environment Affects Production, Reproduction, and Health Proceedings of the International Livestock Environment Symposium, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, April 17-19, 1974, p. 209-210. 1 tab.

Descriptors: Performance, Air pollution, Gases, Dusts, Hydrogen sulfide, Ammonia.
Identifiers: Swine, Animal health.

The effects of ammonia, hydrogen sulfide, and hog-house dust, alone and in various combinations in the air, on the performance and respiratory-tract health of otherwise healthy growing and finishing pigs were studied in 7 trials. The performance trials were conducted in 4 dynamic-type, air-pollutant exposure chambers. The air temperature was about 18 degrees C at all times in all chambers. The absolute humidity level of the air in all chambers was the same as or lower than that of the outside air. Crossbred pigs were assigned to the 4 chambers from within littermate quartets of the same sex. Pigs were fed a corn-soybean meal diet formulated to contain 22.5 percent crude protein to 18 kg and 16 percent from 18 kg on. The diets contained no antibiotic and were pelleted. Results suggested that the performance of healthy pigs may not be affected by air pollution inside enclosed swine houses. The possibility remains that the incidence and severity to lung disease in pigs may be related to the stress caused by such irritating air pollutants as ammonia. If lung disease were exacerbated by air pollutants, pig performance would be expected to decline in turn as an indirect effect of air pollution. (Rowe-East Central)

### 3368 - A7, B1
### CONSTITUENTS OF SWINE HOUSE ODORS,

Professor, Iowa State University, Ames.
E. G. Hammond, P. Kuczala, G. A. Junk, and J. Kozel
Livestock Environment Affects Production, Reproduction, Health, Proceedings of the International Livestock Environment Symposium, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, April 17-19, 1974, p. 364-372. 5 fig, 19 ref.

Descriptors: Odor, Measurement, Confinement pens, Gases, Gas chromatography, Mass Spectrometry.
Identifiers: Swine.

This study reports a number of odorous compounds from the air in a swine confinement building which were identified by gas chromatography, mass spectrometry combined gas chromatography-mass spectrometry and other ancillary techniques. A number of relatively non-odorous compounds tentatively identified solely by combination gas chromatography-mass spectrometry are also reported. Air was sampled in a 700-head swine-finishing building of the Iowa State University Swine Nutrition Research Farm where manure was flushed out hourly with water, and feed was dumped onto the floor of the pens from an overhead conveyor. The odor of the unit was typical of swine but was not an outstandingly intense odor source. Conclusions drawn were: (1) All of the odorous compounds that were found in swine house air were well known flavor constituents in foods. (2) Study results suggested that the number of odorous compounds may be direct products of animal metabolism. (3) Constituents which are below threshold may interact with each other and with constituents above threshold to change the character and strength of the sensation. (4) Possibly some constituents of importance may have escaped the concentration and separation methods. (5) Relatively large amounts of aromatic hydrocarbons were detected in swine house air. (6) It should be possible to develop routine tests for the odorous substances reported, and such analyses should give an objective measurement that will correlate well with the complicated subjective measurements of air quality. (7) One or more of the odorous substances may prove to be a good indicator compound for the intensity and character of the odors from animal facilities. (Rowe-East Central)

### 3369 - A7, A11, B2, C2
### MANURE GASES AND THEIR EFFECT ON LIVESTOCK HEALTH,

Royal Agricultural College, Department of Farm Buildings, Lund, Sweden.
K. Sallvik
Livestock Environment Affects Production, Reproduction, Health, Proceedings of the International Livestock Environment Symposium, Nebraska Center for Continuing Education, University of Nebraska, Lincoln, April 12-19, 1974, p. 373-377. 3 fig, 2 tab.

Descriptors: Liquid wastes, Confinement pens, Air pollution, Ventilation, Design, Gases.
Identifiers: Animal health.

The Department of Farm Buildings at the Royal Swedish Agricultural College investigated the effects of different ventilation systems on the gases produced by liquid manure systems. The ventilation systems tested were: (1) High exhausting - fans in ceiling and inlets along side walls. (2) High exhausting - modified with special inlets in center of building, (3) Low exhausting - exhaust ducts parallel with manure channel suck the outgoing air through openings under the slatted floor or manure gutter. Analyses of air movements and $H_2S$, $NH_3$, and $CH_4$ were made in order to obtain a measure of the efficiency of the ventilation systems. The comparisons between different ventilation systems required that the manure be agitated. The tests showed that the location of air inlets is very important. The air inlets should be located over the feeding table and the incoming air directed toward the breathing zone of the animal. Low exhaust and high exhaust have such an inlet design. In piggeries investigations of air movements, gas concentrations and checking of weight gain and health were made. Feed conversion, weight gain, mortality and classification were recorded. It was found that the 2 ventilation systems can be assumed to be equal regarding good environmental conditions in houses with liquid manure handling. (Rowe-East Central)

### 3370 - B3, C1, C2, D2, E3
### FERMENTATION OF WHOLE FEEDLOT WASTE AND ISOLATED WASTE FIBER WITH TRICHODERMA VIRIDE IN SUBMERGED CULTURE,

Northern Regional Research Laboratory, Agricultural Research Service, U. S. Department of Agriculture, Peoria, Illinois 61604
H. I. Griffin and J. H. Sloneker
Reprinted from Symposium on Enzymatic Hydrolysis of Cellulose, Aulanko, Finland, March 12-14, 1975, p. 419-431. 2 fig, 4 tab, 14 ref.

Descriptors: Fermentation, Fungi, Chemical treatment, Chemical properties, Physical properties, Recycling, Carbohydrates, Cellulose, Nitrogen, Lignins, Separation techniques.
Identifiers: Trichoderma viride, Refeeding, Hemicellulose.

At the Northern Regional Laboratory, fermentation by the fungus Trichoderma Viride was examined as a possible means of decreasing the bulk of cattle feedlot waste and increasing the quality of its protein so that it could be refed as a feed supplement without interfering with animal feed efficiency. The point of attack by Trichoderma Viride is the structural carbohydrates, cellulose and hemicellulose. When crude feedlot waste fiber is separated from the whole feedlot waste, Trichoderma viride ferments it better, achieving a maximum loss of solids of about 38 percent. Crude protein increases and improves the feed additive potential of the feedlot waste; however, other methods, such as mixed culture and solid-state fermentation, will be necessary to increase solids digestion to a level permitting efficient recycling of animal waste. (Rowe-East Central)

### 3371 - A11, B3, C2, E3
### RECYCLING POULTRY WASTE,

Agricultural Research Council's Poultry Research Centre, King's Building, West Mains Road, Edinburgh EH9, 3JS, Scotland
R. Blair
Canadian Poultry Review, Vol. 97, No. 9, p. 13-14, 16, 18, September, 1973. 1 fig, 5 tab.

Descriptors: Recycling, Economics, Nutrients, Pathogenic bacteria, Chemical properties, Performance, Poultry.
Identifiers: Refeeding, Dried poultry wastes, Scotland.

Recycling dehydrated poultry waste (DPW) through poultry has been advocated for 2 reasons: it is a useful source of nutrients and recycling should help to reduce the pollution problem. Research performed at Edinburgh, Scotland, has revealed that, under certain price situations, dehydrated poultry waste is an economic feed for poultry, mainly as a source of energy, amino acids, calcium, and phosphorus. Recycling would reduce pollution by about one-third and possibly more if a level higher than 20 percent in the ration could be tolerated by hens. Proper processing seems to render poultry wastes innocuous and pathogen free. The risk from residues is potentially greater although the scant evidence available suggests than no serious accumulation may take place even on continual recycling. (Rowe-East Central)

## 3372 - A11, A12, B3, C2, E3

### POULTRY EXCRETA CONTAINING POLYCHLORINATED BIPHENYLS AS A PROTEIN SUPPLEMENT FOR LACTATING COWS,

Agricultural Environmental Quality Institute, Agricultural Research Center, U. S. Department of Agriculture, Beltsville, Maryland 20705
L. W. Smith, G. F. Fries, and B. T. Weinland
Journal of Dairy Science, Vol. 59, No. 3, p. 465-474. March, 1976. 1 fig, 8 tab, 16 ref.

Descriptors: Polychlorinated biphenyls, Diets, Dairy industry, Public health.
Identifiers: Refeeding, Dried poultry excreta, Animal health.

A conventional concentrate mixture and a ration containing 32 percent dehydrated poultry excreta were fed to 2 groups of 12 cows each to provide 36 percent of the total dietary nitrogen and 15 percent of the total dry matter intake for 90 days. The objectives were to study: (a) the digestibility, N-metabolism, and milk production of concentrate diets supplemented isonitrogenously with crude protein from conventional sources of or from dehydrated poultry excreta (DPE), and (b) the presence of polychlorinated biphenyls (PCB's) in milk after cattle are fed PCB-contaminated excreta. Manure from caged laying hens fed known concentrations of different PCB's was used. Cattle fed the DPE concentrate consumed less corn silage and concentrates and produced less milk than those fed conventional concentrates. From the feeding of the 2 pelleted concentrates to wethers, it was learned that conventional concentrate ash was 1.5 times more digestible than ash in DPE concentrate. Neither health nor reproductive performance differed in relation to the 2 diets. The conventional concentrate cost $132 /metric ton and the DPE concentrate cost $77 /metric ton as formulated. Pelleting costs were not figured. Residues for chlorinated hydrocarbon pesticides and industrial contaminants were not found to be a problem in utilization of DPE. The residue fed to the chickens from which the excreta was taken was 20 ppm, 100 times as great as the U.S. Food and Drug Administration guideline of .2 ppm for complete animal feeds. The highest residue encountered in milk fat was less than 5 ppm, only twice that listed in the U.S. Food and Drug Administration guideline of 2.5 ppm. Thus, there should be no problem of PCB residues in milk from feeding DPE if the chickens were on diets below 50 times the FDA guideline. (Rowe-East Central)

## 3373 - B2, C2, D3

### NITROGEN REMOVAL FROM A CONCENTRATED WASTE BY NITRIFICATION AND DENTRIFICATION,

Senior Research Associate, Department of Agricultural Engineering, Cornell University, Ithaca, New York 14580
T.B.S. Prakasam, Y. D. Joo, E. G. Srinath, and R.C. Loehr,
Engineering Bulletin, Purdue University, 1974, p. 497-509.

Descriptors: Nitrogen, Denitrification, Nitrification, Wastewater treatment, Ammonia, Aerobic conditions, Anaerobic conditons, Poultry.
Identifiers: Oxidation ditch.

Laboratory and pilot plant scale investigations were conducted to study the feasibility of a microbial nitrification-dentrification process for the control of nitrogen in a concentrated wastewater. In continuous flow units high ammonia residuals were noted, while about only 60 percent of the TKN input was nitrified. Investigations on the causes for the occurrence of a high residual ammonia concentration and efforts to minimize it by nitrification led to the development of a repetitive nitrification-dentrification process for the control of nitrogen in highly concentrated wastes. The elimination of $NO_2$, and $NO_3$ from a partially nitrified waste in a denitrification stage removed the prevailing inhibitory conditions for the oxidation of the residual mixed liquor $NH_4^+$ in a subsequent aerobic phase. Studies with the oxidation ditch showed that by manipulating the rotor operation up to 90 percent of the total nitrogen input could be removed without accumulation of significant ammonia residuals in the mixed liquor. The results of this study showed that the nitrogen in concentrated wastes can be controlled in a single treatment unit such as the oxidation ditch by a nitrification-dentrification process without the necessity of an additional dentrification tank or other appurtenances. (Rowe-East Central)

## 3374 - A11, B3, C1, C2, D2, E3

### A NOTE ON DRIED POULTRY MANURE IN THE DIET OF THE GROWING PIG,

School of Agriculture, University of Aberdeen, Scotland
S. Perez-Aleman, D. G. Dempster, P. R. English, and J. H. Topps
Animal Production, Vol. 13, p. 361-364, 1971. 2 tab, 5 ref.

Descriptors: Diets, Performance.
Identifiers: Dried poultry manure, Swine.

Dried poultry manure was evaluated as an addition to a conventional diet at levels of 10, 20, and 30 percent for growing pigs from 23 to 85 kg liveweight. The manure was obtained from a local broiler producer. The manure was pressure-cooked in Douglas offal plant in lots of approximately 500 kg with about 40 liters of water added to each lot to facilitate the raising of pressure. The material was subjected to a pressure of 68·9 kN $m^{-2}$ and a temperature of 115 degrees C for 35 minutes. Then it was dried by injecting hot air into the cooker for 85 minutes. Thirty-two pigs were arranged in 4 pens to give equal numbers of castrate males and females in 2 pens, all castrates in the third pen and all females in the fourth. The pens were equipped with individual feeding stalls so that the pigs lived as a group but were individually fed to appetite. The food was provided twice daily except on Sunday, when a single meal was given. When the pig consumed all his meal, the amount given at the next meal was increased. There was a tendency for the pigs to eat more as the level of manure in the diet increased. However, the actual food consumption of the pigs on the 4 treatments did not differ significantly. The pigs remained healthy and the dried manure had no apparent adverse effect on the carcasses. For every 10 percent addition of manure, growth was reduced by 0·96. The dried manure contained about 30 percent crude protein and was a rich source of minerals. (Rowe-East Central)

## 3375 - B2, C1, C2, D3

### OVERLAND FLOW IN NARROW PLOTS TO TREAT FEEDLOT RUNOFF,

Assistant Professor, Agricultural Engineering Department, University of Missouri, Columbia, 65201
D. M. Sievers
Presented at 1974 Mid-Central Meeting, American Society of Agricultural Engineers, St. Joseph, Missouri, April 5-6, 1974, Paper No. Mc-74-302, 14 p. 7 fig, 1 tab, 6 ref.

Descriptors: Feedlots, Agricultural runoff, Overland flow, Wastewater treatment, Biological treatment, Nitrogen, Phosphorus, Chemical oxygen demand, Solids.
Identifiers: Lagoon effluent.

Research was conducted at the J. P. Hampton Feedlot near Brunswick, Missouri, to study the effectiveness of the overland flow method of treating cattle feedlot runoff using gated irrigation pipe. Lagoon effluent from a 2000 head feedlot was applied through the gated pipe to plots 150 feet long and 6 feet wide. The plots sloped 5 percent and were covered with Tall Fescue and Reed's Canary. With an application of 5 gpm, 50 percent of the applied ammonia and 35 percent of the total phosphorus was removed within the 150 foot distance. The removal percentages decreased with time. Little change was observed in chemical oxygen demand or solids. Based on study results the use of the overland flow technique for small feedlots using gated irrigation pipe seems questionable. Small feedlots are not likely to have large enough volumes of wastewater for continuous irrigation of the disposal. Under these circumstances, the microorganism population will not develop to a large extent and the quality of the treated effluent will remain poor. The concentrated flow afforded by gated pipe retards establishment of the trickling filter concept and results in poor treatment. For the small feedlot operator who wishes to utilize feedlot runoff through irrigation, it would probably be better to employ a system in which there is little or no runoff produced. If the overland flow system is to be used, sprinkler application is recommended with some means of collecting and recycling the low quality runoff. (Rowe-East Central)

## 3376 - A6, B1

### ODORS FROM EXCRETA OF CATTLE FED SAGEBRUSH AND PEPPERMINT OIL,

Oregon State University, Corvallis
R. O. Kellems, D. C. Church and J. R. Miner
Proceedings, Western Section, American Society of Animal Science, Vol. 27, 1976, 3 p. 1 tab, 6 ref.

Descriptors: Diets, Sagebrush, Sampling, Odor.
Identifiers: Odor control, Peppermint oil, Olfactory panel.

Holstein heifers were fed a basal ration of 25 percent barley and 75 percent alfalfa to which 2 levels (1 percent and 1.5 percent) of ground mountain big sagebrush and one level (0.25 percent) of peppermint oil were added. A control group of 5 replacement heifers was maintained on the basal ration during the experiment period. Fresh urine and fecal samples were collected from the control and the supplemented animals on an individual animal basis. Then composite urine and fecal samples were prepared for each group. Samples containing 50 g feces and 50 g urine were prepared from the composite samples mixed in 300 ml erlenmeyer flasks and incubated at 30 degrees C for 24 hours prior to being evaluated by an olfactory panel. The samples were removed from the water bath, dried, wrapped in paper, and allowed to equilibrate with the ambient temperature for about 30 minutes prior to evaluation. The olfactory evaluations of the groups supplemented with 1 and 1.5 percent sagebrush were not different from the control group. Samples containing both fecal and urine fractions were found to be less offensive than fecal + water samples. A characteristic menthol odor was noted to be present in the urine obtained from the peppermint supplemented animals. It apparently partially masked the normal odor of urine. (Rowe-East Central)

## 3377 - A11, B1, C2, C3, E3, F1, F2

### POTENTIAL 800 MILLION TONS OF ANIMAL FEED GOES TO "WASTE" ANNUALLY, SCIENTIST REPORTS,

Anonymous
Beef, Vol. 12, No. 6, p. 70-71, February, 1976.

Descriptors: Feeds, Farm wastes, Recycling, Performance, Poultry, Cattle, Feedlots, Costs, Economics, Pathogenic bacteria, Legal aspects.
Identifiers: Refeeding, Drug residues.

About 800 million tons of animal feed goes to waste every year in the United States. J. P. Fontenot of the Department of Animal Science at Virginia Polytechnic Institute stated at a seminar that animals annually produce about 1.6 billion tons of waste, of which about one-half could be collected and recycled as animal feed. He added that poultry wastes amount to about 50 million tons of the total. Pathogens, which may be present in poultry wastes, can be destroyed by heat or chemical treatment or by ensiling. While broiler litter may contain medicinal drug residues, no harmful levels have been found in the meat or livers of cattle fed the waste followed by a 5-day withdrawal period. Fontenot indicated that pregnant cows would do well on nearly a 100 percent poultry waste ration and for fattening cattle, the level would be in the 10 to 25 percent range. Feeder Sam Hay, Jr., Covington, Georgia, reported that by recycling manure in his 300-head feedlot, he had saved 20 to 25 percent on feed costs, figuring corn at $3 a bushel. Bobby Joe Lee of Cape Plantation at Tallulah, Louisiana, and George Shepard, manager of the N. B. Hunt Ranch, Dallas, Texas, were both proponents of using corn silage as a basic feed for their cattle. At Lee's feedlot, urea and diacalcium phosphate are added to the silage as it is put into the silo, giving a complete feed to which nothing is added. Brady Anthony of Auburn University reported on a series of feeding trials in which 50 parts of wet manure and 40 parts of ground grass hay were ensiled and then successfully added a basal ration of 82.5 percent ground corn, 12 percent ground Coastal bermudagrass hay, 4 percent of a liquid protein supplement, 1 percent calcium carbonate and 0.5 percent trace mineralized salt. Anthony said, based on the market price of feed ingredients when the feeding trial took place, the manure added at 20, 40, and 60 percent of the ration, reduced feed cost per hundredweight of gain by $4.32, $10.62, and $14.32, respectively. (Rowe-East Central)

## 3378 - A4, B1, F1
## POLLUTION REGULATIONS REMAIN ONE OF THE TOP WASHINGTON ISSUES,

Washington Correspondent
J. Richter
Beef, Vol. 12, No. 9, p. 8,9, May, 1976.

Descriptors: Regulations, Water pollution, Point sources.
Identifiers: Beef imports, Checkoff program.

In their present "final" form, regulations say that feedlot operators won't need pollution permits unless there is some discharge into navigable waters. If there is such a discharge: (1) Operators with as many as 1,000 animal units or 700 mature cows will need permits, (2) Those with 300 to 1,000 animal units will need a permit if the feedlot discharges into a waterway directly or through a manmade channel, (3) Operators with fewer than 300 animal units or 200 cows are to be exempt from the control program, unless they have an unusual pollution problem. A proposed checkoff program is being revived. The Beef Development Taskforce has agreed to go along with the Farm Bureau on procedure for conducting a producer referendum on the plan. The Bureau Plan requires: (1) pre-registration of cattlemen 10 days prior to the referendum, (2) at least half of those registered to vote, and (3) two-thirds approval by all those voting for the checkoff plan to take effect. Beef imports are going to be more closely monitored this year, following last year's fiasco when 27.2 million pounds more beef came into the country than the law allowed. Responsibility for monitoring imports will be shifted from the U. S. Census Bureau to the Customs Bureau. (Rowe-East Central)

## 3379 - C1, C2, C3
## STANDARDIZING PROPERTIES AND ANALYTICAL METHODS RELATED TO ANIMAL WASTE RESEARCH,

American Society of Agricultural Engineers
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, 355 p.

Descriptors: Analysis, Sampling, Chemical properties, Physical properties.
Identifiers: Animal wastes.

To promote an exchange of information which would encourage more uniformity in conducting animal waste research and reporting findings, the ASAE committee SE-412, Agricultural Sanitation and Waste Management, sponsored a conference concerning "Standardizing Properties and Analytical Methods Related to Animal Waste Research" in December, 1972. Approximately 150 engineers and scientists attended. In December, 1974, the ASAE Committee Se-412, Agricultural Sanitation and Waste Management, and T-9, Environmental Quality Coordinating Committee, organized another conference. The purpose of this conference was to summarize and disseminate information concerning changes, refinements, and new developments needed to assess system performance. Papers presented at both of these conferences are included in this publication. (Merryman-East Central)

## 3380 - B1, B2, C1, C2
## PROPERTIES RELATED TO MATERIALS HANDLING,

Assistant Professor, Agricultural Engineering Department, Iowa State University.
R. J. Smith
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 17-25. 10 ref.

Descriptors: Slurries, Design, Pumping, Solids, Physical properties, Chemical properties, Equations.
Identifiers: Manure, Open channel, Chemical precipitation.

This study is divided into: (1) a general discussion of manure composition and how this should be determined, (2) the parameters necessary to measure manure pumping characteristics, (3) the phenomenon of solids transport in an open channel, and (4) a brief section on mechanical problems arising from chemical precipitation. Manure consists of: (1) a liquid containing dissolved and colloidal solids, (2) a fraction containing very find solids, (3) a fraction containing coarse particulate matter, and (4) hair. Pumping raw manure requires certain considerations. Two areas needing numerical characterization are: (1) how readily the material flows into a pump section and (2) head loss incurred in forcing the material through a closed pipe. It is possible to put a numerical index on the onset of suction starvation by examining a curve of sheer stress vs. strain rate. The head loss in a pipe carrying solids that are in heterogeneous suspension can be expressed by: $(J - J_W) / C_V J_W = K(n_1 C_V)m$. J = head loss for water at velocity V in units of height of slurry column per unit length of pipe. J = head loss for water at velocity V in units of height of water per column per unit length of pipe. K,m = dimensionless constants. A dimensional analysis approach based on Raudkivi (1967) may be helpful in planning the design of open conduits. Precipitation of $Mg(NH_4)PO_4$ and CaCO in manure slurries adversely affects pump performance. Measurement of levels of $Mg^{++2}$, $NH_4$+, and $PO_4^{-3}$ may be a waste of time; it is better to design the pumping system using all-plastic components, where possible. Deposits can be dissolved by using 1:20 dilution of glacial acetic acid flushed through the system for about 3 hours. Centrifugal pumps should employ large clearances between the rotor and the case. (Rowe-East Central)

## 3381 - A1, C1, C2, C3, E2, E3
## PROPERTIES RELATED TO ENVIRONMENTAL POLLUTION,

Associate Professor, Agricultural Engineering Department, Oklahoma State University, Stillwater
A. F. Butchbaker
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 26-47. 7 tab, 17 ref.

Descriptors: Pollution, Water pollution, Air pollution, Soil contamination, Recycling, Odor, Dusts, Pathogenic bacteria, Nutrients, Sediments, Radioactivity.
Identifiers: Refeeding.

Determining pollutional parameters of animal wastes is difficult due to the complex nature of the wastes and the variety of management and weather effects. The characteristics of animal wastes vary with ration and animal species. Degradation of the waste causes further changes. In many cases, the impact of the waste on the receptor in the environment is relatively unknown, particularly, for potential long-term effects. To determine the pollutional characteristics of animal waste, the evolvement of water quality standards was reviewed. Four broad categories of media-receiving animal waste may be considered — (1) Water (surface; ground), (2) Soil (crop utilization, disposal), (3) Air (odors, dust), and (4) Utilization or Resource Recovery (Food - Refeeding, Algae production, etc.) Pollutional categories to be considered in water quality include: organic wastes, infectious agents, plant nutrients, synthetic chemicals, inorganic and mineral substances, sediments, radioactivity, and temperature. Some of the pollutional parameters for soil are those that may build up, such as heavy metals, sodium, magnesium, bicarbonates, sulfates, chlorides, potassium and boron. Air pollutants may be categorized as odors and dust. Pollutional parameters to be considered in utilization are dependent upon the actual type of utilization. Besides crop production from irrigation or direct manure application, waste usage may include: food, fuel, and building materials. Food products may also be examined for pathogens, parasites, disease organisms, endocrine secretions, heavy metals, antibiotics and residuals from medicinal compounds. In fuel production, odors and particulate matter are of concern. In creating building materials, if the material is rendered biologically inert by thermal or chemical means or coated with an inert material, few pollutional parameters exist. Guidance in the selection of pollutional parameters may be obtained from the various pollution control and public health agencies. (Rowe-East Central)

## 3382 - A2, C1, C2
## SAMPLING OF LIQUID AND SOLID WASTES,

Agricultural Engineer, Agricultural Research Service, U. S. Department of Agriculture, Lincoln, Nebraska
N. P. Swanson, and C. B. Gilbertson
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972, and December, 1974, p. 63-77. 16 ref.

Descriptors: Sampling, Liquid wastes, Solid wastes, Physical properties, Chemical properties, Agricultural runoff, Equipment, Measurement.
Identifiers: Animal wastes.

This paper discussed appropriate sampling techniques and equipment related to sampling animal wastes and identifies some pertinent properties and their proper units of measurement that should be considered in research. Samples should be random and representative. The what, where, and when should be planned for sampling before initiating research and the decisions as to how many samples and how much to sample should be considered. In sampling solids, the stable masses of organic materials and mixtures of soil and organic materials can be sampled with standard soils sampling equipment. Chemical content, organic and physical content, and bulk density may vary with depth; therefore, it is important to obtain samples with uniform cross sections. Meaningful sampling of runoff requires collection of periodic representative samples to accompany measurements of the rate of discharge by units of time or a runoff hydrograph. Factors that affect reliability in sampling runoff are: (1) Frequency of the sample cutting, (2) Technique used in taking the sample, (3) Safeguarding the sample from contamination, and (4) Sample analysis. Equipment should be selected to best meet the practical needs of the research. Conglomerate samples should be avoided if the details afforded by measurements of stratification, changes with time, or changes in connection with other physical, chemical, or biological phenomenon will add materially to the findings. Data should be analyzed promptly to insure that sampling procedures and equipment are adequate. (Rowe-East Central)

## 3383 - C2, C3
## SAMPLING OF LIQUID AND SOLID WASTES,

Assistant Professor, Agricultural Engineering Department, University of Wisconsin, Madison.
J. C. Converse
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 78-84. 9 ref.

Descriptors: Sampling, Liquid wastes, Solid wastes, Equipment, Preservation, Chemical properties, Physical properties, Analysis.

A discussion is given of the following: (1) the different types of samplers available, (2) sampling statistically, (3) preservation of samples prior to analysis, and (4) preparation of samples for obtaining a representative aliquot from the sample for analysis. The author states that it is better to obtain 2 samples at the same time and make one analysis on each than to take 1 sample and duplicate analyses. This will reduce the likelihood of error. Wood and Stanbridge (1968) determined that it is advisable to incorporate a refrigerator into an automatic sampler to keep samples at 5 degrees C to minimize changes in nitrate and biochemical oxygen demand. In remote locations where refrigeration is not feasible, phenyl mecuric acetate may satisfactorily preserve a runoff sample. Other preservation techniques are also available. No research results have been found concerning the effect of freezing on BOD, COD, total solids, suspended solids, and other characteristics. In evaluating the degree of preparation, the samples can be divided into 4 categories - liquid, semi-solid, solid, and dried samples. Liquid samples need no preparation. Semi-solid samples may contain enough large solids that they have to be broken so a representative aliquot can be taken for analysis. This may be done with a blender. Solid samples can be ground into a uniform mass with a Hobart grinder. Dried samples may also be ground before analysis. It is most unfortunate that more defined procedures are not available on sampling techniques like those for analytical work. Sampling is a very integral part of the research, but it is the impression of the author that more emphasis should be placed on developing reliable sampling techniques. (Rowe-East Central)

## 3384 - C1, C2, C3
### SAMPLING OF GASES AND AEROSOLS

Assistant Professor, Agricultural Engineering Department, The Ohio State University, Columbus, 43210
R. K. White and D. P. Stombaugh
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 85-109. 3 fig, 1 tab.

Descriptors: Sampling, Gases, Aerosols, Equipment, Dusts, Mist, Bacteria.
Identifiers: Data reporting, Impingement.

The following were discussed: (1) general sampling procedures and equipment, applicable to both gases and aerosols, (2) specific equipment and procedures unique to either aerosol or gas samplings, and (3) the type and form of data reporting. Only aerosols and gases of agricultural origin were considered. Principle aerosols considered were: soil particles from tillage operation, harvesting dust, fertilizer, lime dust, dust from animal and poultry units, mist from pesticide applications, pollen, bacteria, fungi, and smoke. Gases considered were: hydrogen sulfide, ammonia, carbon dioxide, and methane. Specific aerosol sampling procedures that were discussed included: settlement, filtration, and impingement. Specific gas sampling procedures that were discussed included: adsorption and absorption. Check lists were included which can be used for reporting sampling procedures. (Rowe-East Central)

## 3385 - C1, C2, C3
### SAMPLING GASES AND AEROSOLS,

Research Associate, Department of Agricultural Engineering, Cornell University, Ithaca, New York.
A. T. Sobel and D. C. Ludington
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December 1972 and December, 1974, p. 110-113. 1 tab.

Descriptors: Sampling, Gases, Aerosols, Equipment, Ammonia, Poultry, Ventilation.

Many aspects of sampling gases and aerosols were discussed, including precautions which must be considered. In relation to gas scrubbing equipment, the following comments were made: (1) When using fritted-glass scrubbers, it should be kept in mind that each unit has its own flow characteristics and units should not be interchanged without noting flow changes. (2) Fritted-glass units will change their flow characteristics with time and must be cleaned, usually in acid, periodically. (3) Air flow should be recorded at the beginning and end of sampling when using flow rate meters. (4) For multiple use of gas scrubbers, a constant vacuum source tank is valuable. (5) Indicating flow meters may be used to measure the quality of air that passes through the collector. A specific example is outlined for using gas scrubbing to measure the concentration of ammonia in poultry house ventilation air. The method was absorption of ammonia in dilute acid and measurement of direct nesslerization. (Rowe-East Central)

## 3386 - A6, B2, C1, C2
### ANALYZING PHYSICAL AND CHEMICAL PROPERTIES OF LIQUID WASTES,

Senior Research Associate, Cornell University, Ithaca, New York, 14850
T. B. S. Prakasam, E. G. Srinath, and P. Y. Yang
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 114-166. 9 fig.

Descriptors: Physical properties, Chemical properties, Liquid wastes, Sampling, Analysis, Nitrogen.
Identifiers: Odor control.

Research and demonstration studies were conducted on the treatment of poultry wastes obtained from the Poultry Research Farm, Cornell University, with particular emphasis on nitrogen control, waste treatment, and odor control. A variety of analytical methods were evaluated for their applicability to the routine analysis of animal and especially poultry wastewaters. Parameters analyzed were: (1) Physical: total and suspended solids, (2) Chemical: chemical oxygen demand, $NH_4$-N, TKN, and phosphorus, and (3) Biochemical: biochemical oxygen demand, (BOD)* and nitrogenous oxygen demand (NOD). (Rowe-East Central)

## 3387 - B2, C1, C2
### ANALYZING PHYSICAL AND CHEMICAL PROPERTIES OF LIQUID WASTES,

Associate Professor, Biological and Agricultural Engineering Department, North Carolina State University, Raleigh
F. J. Humenik and M. R. Overcash
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972, and December, 1974, p. 167-182. 3 fig, 3 tab, 3 ref.

Descriptors: Liquid wastes, Chemical properties, Physical properties, Sampling, Equipment, Centrifugation, Ammonia, Nitrogen, Nitrates.
Identifiers: Electrode techniques.

The paper, "Evaluation of Methods for the Analysis to Physical, Chemical, and Biochemical Properties of Poultry Wastewater", by T. B. S. Prakasam, E. G. Srinath, P. Y. Yang, and R. C. Loehr has advanced the continuing quest for the most accurate, convenient, and rapid method of analysis, especially when a number of parameters must be tested to properly evaluate complex agricultural wastewaters. The results which they report concerning storage of samples are important and should be included in any critical evaluation of published data. Prakasam, et. al., have shown that the centrifugation method is a reliable estimate of suspended solids and have thus recommended centrifugation with subsequent drying of the sediment for this determination. Results of Prakasam et al for the rapid COD test are very encouraging. The determination of ammonia and organic nitrogen by the standard Kjeldahl method is the most tedious and lengthy analysis that is routinely made in most laboratories. Work is in progress to reduce the time requirements of this method by using the Orion Ammonia electrode. Determination of nitrate in soil-water interflows by means of the Orion specific ion electrode and the ultraviolet spectrophotometric test has had good results. More attention should be given to new and more rapid instrumental and electrode techniques. These techniques will require refinement before confident routine employment can be made for animal wastes, but time and labor benefits will be enormous. (Merryman-East Central)

## 3388 - C1, C2
### ANALYZING PHYSICAL AND CHEMICAL PROPERTIES OF SOLID WASTES,

Agricultural and Microbiologist, U. S. Department of Agriculture, Agricultural Research Service, Lincoln, Nebraska
C. B. Gilbertson, T. M. McCalla, and A. T. Sobel
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972, and December, 1974. p. 183-196. 2 tab, 41 ref.

Descriptors: Physical properties, Chemical properties, Solid wastes, Analysis.
Identifiers: Livestock wastes, Poultry wastes.

Physical and chemical analyses required to define the nature of livestock and poultry wastes were outlined. The following procedures may be used in analyzing these physical properties: Total solids (moisture content) — oven dry to constant weight; Fixed solids (Volatile solids) — combustion; Settleable solids — Imhoff cone test; Nonfiltrable solids — vacuum filter; Partical size — wet sieve analysis; Bulk density, specific—gravity—weight/volume measurement phychometer; Flow characteristics — (a) slump test — slump cone; limit; (b) viscosity — stormer viscometer, coaxial cylinder viscometer; Compaction — proctor density test; Liquid and shrinkage limits; Moisture removal — physical and thermal; Equilibrium moisture content — temperature-controlled container; Gross energy — bomb calorimeter; Freezing point — thermocouple; Waste production — laboratory/field collection; Odor — nose; Specific heat — method of mixtures; Thermal conductivity — thermal conductivity probe. Chemical procedures which may be used for analyzing the following properties are: pH—pH meter; EC — conductivity meter; D.O. — dissolved oxygen meter; BOD — 5 day incubation; COD — dischromate reflux method; Odors — gas chromatograph; Total organic carbon — combustion; Total N — micro-Kjeldahl procedure; $NO_2$-N — steam distillation and colorimetric; $NO_3$-N — steam distillation and colorimetric; $NH_4$-N — steam distillation and colorimetric; Total P — ashing, acid extraction, flame photometer; Fe, Cu, Mn, Zn, B, As, Hg — digestion acid extraction, atomic absorption; Cl, I — digestion, acid extraction, colorimetric of gravimetric methods; Digestibility — in vitro digestion with ruminant fluid; Antibiotics — thin-layer chromatography; Pesticides, insecticides — extraction with water and organic solvents; measured in gas chromatograph. The physical properties of animal wastes will be affected by such properties as ration fed, animal environment, climatic conditions, feedlot management, and microbial activity. These variations have made it difficult to develop guidelines for laboratory analyses. By adapting existing techniques and introducing some new ones, information on animal wastes can be documented to assist in basic understanding of the material. (Rowe-East Central)

## 3389 - B3, C1, C2
### ANALYZING PHYSICAL AND CHEMICAL PROPERTIES OF SOLID WASTES,

Instructor, Agricultural Engineering Department, University of Minnesota, St. Paul 55108
J. A. Moore
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and De-

cember, 1974, p. 197-204. 2 fig.

Descriptors: Solid wastes, Chemical properties, Physical properties, Analysis.

The analysis of solid animal waste is being approached by people in several disciplines by researchers throughout the United States. It is, therefore, very important to develop a uniform technique for the methods not listed in STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER. There are no "standard methods" for many of the tests dealing with solid animal wastes. Testing methods, most of which vary from published methods, are discussed. For uniformity in the published literature, the author recommends that 104 degrees C be accepted and used as the standard drying temperature for solid determinations unless a different temperature is stated. Two techniques for filtering suspended solids are: (1) Dilute the semi-solid waste material until the suspension is thin enough so as not to plug up the filter before achieving most of the filtering process. (2) Prefilter the sample. Wet screening has been found to be the most successful method in describing particle size distribution. A crude but useful technique for determining flow characteristics is to measure the angle of internal friction or angle of repose. Equilibrium moisture content may be determined by measuring the humidity or dew point in a closed container or by placing manure samples in a jar, at a constant temperature with a known salt solution in the environment. A bomb calorimeter can be used to measure the decrease over time in total energy of the solids remaining in a continuous aerated treatment system. Determinations of dissolved oxygen may be made through use of dissolved oxygen meters. Nitrate and nitrite measurements may be determined colorimetrically. A chromotropic acid method may also be used for nitrate analysis. (Merryman-East Central)

### 3390 - A6, A7, C2, C3
## ANALYTICAL METHODS RELATED TO ANIMAL WASTE RESEARCH: GASES AND AEROSOLS,

Associate Professor, Agricultural Engineering Department, Oregon State University
J. R. Miner
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 205-215. 3 tab, 28 ref.

Descriptors: Gases, Aerosols, Analysis, Sampling, Ammonia, Hydrogen sulfide, Odor.
Identifiers: Livestock wastes.

Interest has been generated in the analysis of gases due to possible toxic effect of manure related gases to confined animals, accelerated material degradation, and the potential spread of disease from wind-carried aerosols. Gas analysis techniques basically fit the following classifications: (1) Ammonia, (2) Hydrogen sulfide, (3) Odorant identification, and (4) Aerosol monitoring. At concentrations of approximately 0.3 - 0.5mg 1, ammonia acts as an irritant to the eye, nose, and throat of humans. At high concentrations, it acts as an asphyxiant. Similar reactions have been noted in the response of domestic animals. The most widely used method of ammonia analysis has been selective ammonia absorption followed by color formation using Nessler's reagent. Ammonia may also be determined by moistening pH test paper with distilled water and exposing it to the air for 15 seconds. Excessive amounts of hydrogen sulfide are also toxic to humans and animals. Methods for measuring hydrogen sulfide include: (1) a titration procedure, (2) a colorimetric procedure, and (3) modification of the method for analyzing hydrogen sulfide concentrations in wastewater as prescribed in STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER. Odorant identification techniques are numerous and varied. Included among them are: (1) Paper chromatography, (2) Ammoniamine absorption on silica gel treated with minhydrin, (3) Gas chromatography electron capture detector, and (4) Gas chromatography flame ionization detector. An Anderson sampler which impinges bacterial particles contained in air upon petri dishes located at various stages within the sampler may be used in aerosol monitoring. (Merryman-East Central)

### 3391 - A6, A7, C2
## ANALYZING PHYSICAL AND CHEMICAL PROPERTIES OF GASES AND AEROSOLS,

Associate Professor, Agricultural Engineering Department, Clemson University, Clemson, South Carolina 29631
G. L. Barth
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 216-224. 4 fig, 16 ref.

Descriptors: Physical properties, Biological properties, Gases, Aerosols, Odor, Air pollution, Legal aspects, Measurement.
Identifiers: Odor intensity.

Animal producers must anticipate that air pollutants originating from their operations are going to be regulated more firmly in the future. Hopefully the technology for odor emission control will keep pace with the technology for odorant concentration determination. The following classification distinguishes between odorous and non-odorous gaseous compounds. (1) Odorants — ammonia, hydrogen sulfide, volatile organic acids, amines, alcohols, carbonyls, mercaptans, and disulfides, and (2) Non-odorants — carbon dioxide and methane. The necessity for objective odor intensity measurement becomes apparent when faced with the fact that some state air pollution control regulations contain limits on odor intensity. At least 8 states and the District of Columbia now include such standards. Methods for measuring odor intensity are outlined. (Merryman-East Central)

### 3392 - A11, A12, B1, C3, D3, E2
## ANALYZING BIOLOGICAL PROPERTIES OF WASTES,

Professor, Microbiology Department, South Dakota State University, Brookings 57006
P. R. Middaugh
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 238-245. 22 ref.

Descriptors: Biological properties, Odor, Waste treatment, Bacteria, Public health, Clostridium, Bacteroides.
Identifiers: Farm wastes, Land disposal, Pathogens, Animal health.

The need for economic, rapid stabilization of animal wastes with control of odors, ammonia, and other objectionable characteristics will require the application of all available knowledge of the biological characteristics of farm animal wastes. Commercial operators of livestock enterprises and investigators studying waste materials handling and ultimate disposal of livestock wastes on land can appreciate the value of bacteria, both as built-in indicators of environmental pollution and as the means of stabilization of organic wastes. Development of standardized methods for detection of the major pathogenic enteric microorganisms including bacteria, viruses, fungi and protozoa should be a major objective for improved environmental health for both farm animals and man. Methods for determining clostridium and bacteroids are discussed. Microorganisms and their association with odor control are also discussed. (Merryman-East Central)

### 3393 - A5, A8, B2, B3, C1, C2
## SAMPLING OF LIQUID AND SOLID ANIMAL WASTES,

Associate Professor, Texas A&M University, College Station
D. L. Reddell, J. I. Sewell, C. B. Gilbertson, and H. C. Zindel
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 258-281, 2 fig, 8 tab, 13 ref.

Descriptors: Sampling, Liquid wastes, Solid wastes, Agricultural runoff, Slurries, Equipment, Chemical properties, Physical properties, Irrigation.
Identifiers: Soil sampling, Crop sampling, Groundwater sampling, Land disposal.

The sampling of liquid and solid animal wastes is discussed in terms of 4 broad categories — manure sampling, crop sampling, soil sampling and ground water sampling. For each of these categories, the following are described: (1) the equipment used to collect representative manure, soil, crop, and groundwater samples, (2) the sampling techniques required to characterize an entire mass of heterogeneous material, and (3) where possible, the variability inherent in the sampling procedure. (Rowe-East Central)

### 3394 - A6, A7, C2
## SAMPLING AND ANALYSES OF GASES/ODORS,

Assistant Professor, Department of Agricultural Engineering, Ohio State University, Columbus 43210
R. K. White, C. L. Barth, D. C. Ludington, and J. R. Miner
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 282-296. 7 tab, 29 ref.

Descriptors: Sampling, Analysis, Gases, Odor, Absorption, Adsorption, Condensation, Ammonia, Hydrogen sulfide, Carbon dioxide, Methane, Equipment.
Identifiers: Livestock wastes.

The methodology and equipment suitable for sampling and analyzing gases /odors from livestock wastes are discussed. Gases may be collected by: (1) admitting the gas into an evacuated bulb of known volume (2) utilizing a rigid container filled by gas displacement, or (3) utilizing non-permeable, collapsible bags which can be filled by a blower or a pressurized source of the gas. Gas concentration is usually accomplished by absorption, adsorption, or condensation. There are 4 gases commonly associated with decomposition of animal wastes: ammonia, hydrogen sulfide, carbon dioxide and methane. The first 2 are odorous while the last 2 are non-odorous. Gas chromatography is the principal analytical tool for measuring odorants. Gas chromatograms can be calibrated for quantitative analysis using a measured amount of a known compound. When peak areas on gas chromatograms for an odorant from a waste sample are compared with calibration curves, the concentration of the odorant can be determined. Research has indicated that the only way to evaluate an odor is to sniff the odor with the nose. There are 2 basic ways of measuring the strength of an odor with the nose. One is by sniffing the odor emanating from the source directly and ranking the odor strength based on a predetermined scale. The other is to dilute the odor until the odor is no longer perceptible or the odor threshold is attained. The amount of dilution required to achieve this threshold is used as a measure of the odor strength. Commercial equipment for sampling and measuring gases of importance in livestock waste management is not readily available. The few field devices available have evolved because of the need for more convenient techniques to gather samples in the field, usually by adapting measurement devices built for some other application. However, most measurements are made by using modifications of laboratory procedures, adapted for field use. (Merryman-East Central)

### 3395 - C2
## ANIMAL WASTE SAMPLE PREPARATION AND PRESERVATIVE,

Instructor, Agricultural Engineering Department, University of Minnesota, St. Paul
J. A. Moore, M. R. Overcash, and T. B. Prakasam
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972, and December, 1974, p. 297-332. 53 fig.

Descriptors: Sampling, Preservation, Analysis, Chemical properties, Poultry, Cattle.
Identifiers: Swine, Dairy cattle.

Research was done to establish the magnitude and rate of any transformation that occur in animal waste samples as a function of the preparation and/or preservation techniques. In most operations, there is a time lag between sampling and analysis of animal waste. A wide variety of preservation techniques are commonly used. For the purpose of this study, samples were handled in the following ways: stored at room temperature, refrigerated, frozen, and acidified. Comparisons were made of the impact of these techniques on the different parameters considered in the individual studies. Samples were taken from fresh manure (feces + urine), fresh feces, lightly loaded lagoon, heavily loaded lagoon, oxidation ditch mixed liquor, and soil column leachates. They were measured for some, though not necessarily all, of the following parameters: Total Kjeldahl nitrogen, ammonia, nitrates, nitrites, chemical oxygen demand, total organic carbon, conductivity, and pH. The wastes originated from beef cattle, dairy cattle, poultry, and swine. Actual sample preparation techniques, preservation techniques, data analysis, results, and conclusions are outlined for the studies that were conducted. (Merryman-East Central)

### 3396 - C1, C2
### EVALUATION OF CHEMICAL ANALYSES FOR ANIMAL WASTES,

Assistant Professor, North Carolina State University, Raleigh
M. R. Overcash, A. G. Hashimoto, D. L. Reddell, and D. L. Day,
Standardizing Properties and Analytical Methods Related to Animal Waste Research, American Society of Agricultural Engineers, December, 1972 and December, 1974, p. 333-355. 17 tab, 9 ref.

Descriptors: Chemical analyses, Physical properties, Chemical properties, Costs, Quality control.
Identifiers: Animal wastes.

Chemical procedures for analyzing animal wastes were reviewed. The parameters chosen for study included physical properties, chemical oxygen demand, carbon, forms of phosphorus, forms of nitrogen, and certain metal elements. Procedures were compared. Validity of tests for recovery of known addition, estimated test variability, rate of analyses, and cost factors were all discussed. The need for a quality control program was stressed. (Merryman-East Central)

### 3397 - A4, B1, C1, F2
### SIMULATED BEEF FEEDLOT BEHAVIOR UNDER ALTERNATIVE WATER POLLUTION CONTROL RULES,

Assistant Professor of Agricultural Economics, Ohio State University
D. L. Forster
American Journal of Agricultural Economics, Vol. 57, No. 2, p. 250-268, May, 1975. 1 fig, 5 tab, 17 ref.

Descriptors: Model studies, Feedlots, Water pollution, Management, Costs, Legal aspects, Michigan.

In order to investigate the impact of alternative rules established by federal and state agencies concerning water pollution from feedlots, a simulation model was constructed to represent the behavior of beef feedlots in Michigan and similar states over the 1974-85 period. The model's 4 components were: (1) the farm feedlot component which assumed a whole farm approach to feedlot production by simulating feedlot design and beef production, the production of crops necessary to feed the cattle, the transportation of crop from field to storage facilities, the design of feed storage facilities, and the removal of wastes to the fields, (2) ex ante and ex post price equations which were used to represent the feedlot operator's price expectation and output and input prices which were actually experienced by the operator, (3) a decision-making process which determined the type and level of inputs employed and which was used during each time period by each simulated firm, and (4) an optimization procedure, which was employed to find the values of 4 unknown parameter values. It was concluded that the beef feedlots of less than 1000-head capacity would change their performance only slightly under any of the alternative water pollution control rules tested. Other results from the analysis indicated that costs which the feedlots would bear as a result of the rules investigated vary with feedlot technology. As a means of conducting such investigations, the model was found to have disadvantages in terms of the cost requirements of the analysis, but to have advantages in terms of its flexibility and dynamic attributes. (Rowe-East Central)

### 3398 - A4, A7, B1, C2
### CONTAMINATION OF WATER BY AIR POLLUTANTS, ESPECIALLY FROM ANIMAL MANURES,

University of Georgia, Athens
J. Giddens
Completion Report, USDI OWRI Project No. A-050-GA, Department of Agronomy, University of Georgia and Environmental Resources Center, Georgia Institute of Technology, December, 1975, 19 p. 4 tab, 20 ref.

Descriptors: Water pollution, Ammonia, Poultry, Cattle, Nitrogen, Sulfur, Georgia, Precipitation (atmospheric).
Identifiers: Air pollutants.

Ammonia traps using .01N $H_2SO_4$ were placed near poultry and beef cattle operations. Up to 66 kg/ha ammonia was trapped near the animal operations. At distances greater than 500 to 800 meters away, there was no effect from the animals but there was still about 15 kg/ha/yr of ammonium nitrogen trapped. Precipitation was collected at 8 rural locations in Georgia during 1974 and analyzed. The water pH ranged from 4.1 to 5.6. The amounts of fertilizer elements and heavy metals in precipitation, except nitrogen and sulfur, were negligible when considered from the overall content of these elements in soils. The water was low in chemicals when compared to that reported for industrialized and traffic congested areas. (Giddens-University of Georgia)

### 3399 - B2, B3, D1, D3, E2, E3
### AUTOMATED PIG WASTEWATER TREATMENT AND EFFLUENT RECYCLE,

Professor of Agricultural Engineering, Agricultural Pollution Control Research Laboratory, Agricultural Engineering Department, Ohio State University, Columbus
E. P. Taiganides, C. R. Mote and R. K. White
Proceedings of the 28th Industrial Waste Conference, Part 2, Purdue University, May 1-3, 1973, p. 778-783. 4 fig, 1 tab, 3 ref.

Descriptors: Waste treatment, Wastewater treatment, Recycling, Liquid wastes, Solid wastes, Performance.
Identifiers: Land disposal, Swine.

A system which appears to have good potential for meeting the waste handling and treatment requirements of the nation's pork producers was built in 1971 on the Research Farm of Botkins Grain and Feed Co. and has been operated as a demonstration project for 2 years. The treatment plant received all the waste produced in a 500 head capacity swine growing and finishing barn. As long as the proper population is maintained, the pigs defecate on the slatted floors and in the gutters and their movement forces the wastes through the slatted floor into a channel below. From here, the water is periodically flushed by siphon flush tanks. The slurry thus formed flows into a sump from which it is pumped to a stationary screen. Solids removed by the screen drop into a solids treatment unit. The effluent goes into an oxidation ditch. Effluent mixed liquor from the ditch flows into the center of a gravity clarifier. Clarified effluent flows into a storage well. Water from the storage well is pumped into the flush tanks for reuse. Settled sludge from the bottom of the clarifier is pumped back into the ditch. Satisfactory operation of the ditch is maintained by regularly wasting some of the sludge from the clarifier to the solids treatment unit. Effluent from the solids treatment unit flows into the solids storage tank. Periodically solids from the storage tank are field spread. Performance of the system may be generalized as follows. The automated flushing has worked extremely well. Odor in the building has been minimal and the pigs have been very clean. Winter freezeup of the treatment plant has been avoided by covering it with plywood and using some type aerator other than a surface aerator. Foaming of the oxidation ditch during cold weather has been satisfactorialy combatted by using a foam suppressing drum or a high velocity spray. General performance of the plant is better in warm weather than in cold. (Rowe-East Central)

### 3400 - B2, B4, C1, D1, E2
### INFLUENCE OF PRELIMINARY TREATMENT AND STORAGE ON THE ORGANIC CONTAMINATION OF LIQUID MANURE,

Beitrag aus dem Institut fur Wasserwirtschaft, Berlin
D. Kramer and C. Konrad
Wasserwirtschaft Wassertechnik, Vol. 20, No. 6, p. 189-193, June, 1970. 7 tab, 19 ref.

Descriptors: Liquid wastes, Hydrologic aspects, Cattle, Waste storage, Sampling, Fertilizers, Separation techniques.techniques.
Identifiers: Swine.

A hydrological assessment of liquid manure is presented. Agricultural practices which are unsatisfactory from the standpoint of water resources protection are criticized. Results of investigations of organic contamination by liquid manure of cattle and pigs are discussed in relation to the duration and kind of storage and the influence of phase separation. To avoid undue scatter of measured data due to the use of different sampling procedures, a standard procedure is proposed in which the sample is taken without disturbing the natural stratification 5 cm below the surface, or the floating cover of the liquid. No perceptible decrease of organic contamination was found using the above mentioned parameters when the liquid manure was stored for a maximum of 358 days. Phase separation had a definite influence on the hydrological contamination potential of the liquid manures. However, even though the sediment constituting (in the mean) 30 percent of the raw liquid manure contains 60 percent of the total organic contamination, the centrifuged liquid, constituting the other 70 percent, still is an organically strong contaminated liquid. This contaminated liquid requires a highly effective method of decontamination for use as a fertilizer in agriculture. (Solid Waste Information Retrieval System) (In German)

### 3401 - A8, C2, E2
### EFFECTS OF BEEF-FEEDLOT MANURE AND LAGOON WATER ON IRON, ZINC, MANGANESE AND COPPER CONTENT IN CORN AND IN DTPA SOIL EXTRACTS,

Research Assistant, Kansas State University, Manhattan 66505
G. W. Wallingford, L. S. Murphy, W. I. Powers, and H. L. Manges
Soil Science Society of America Proceedings, Vol. 28, No. 3, p. 482-487, 1975. 5 fig, 4 tab, 25 ref.

Descriptors: Feedlots, Cattle, Crop response, Nutrients, Iron, Zinc, Manganese, Copper, Corn, Trace elements.
Identifiers: Land application, Lagoon water, Soil extracts, Soil cores, Micronutrients.

The effects of beef-feedlot manure and lagoon water on DTPA extractable iron (Fe), zinc (Zn), manganese (Mn), and copper (Cu) of a silty clay loam soil, concentrations of these elements in corn forage and leaf tissue, and their uptake by corn forage were studied in the field. Soil cores were taken from the surface 1 m of sets of plots which had received 2 annual applications of manure and 3 annual applications of feedlot lagoon water. DTPA extractions were performed on these cores. It was found that in the 2 years, annual application of beef-feedlot manure did not appreciably change the pH of the neutral-to-alkaline soil studied, though soil availability of Fe, Zn, Mn, and, to a lesser extent, Cu was increased. Three years of field data showed that applications of manure enhanced corn-leaf and forage concentrations of Zn and Mn and corn-forage uptake of Mn. The Mn plant data were consistently highly correlated with the cumulative manure applied, the increased availability of Mn probably resulting from chemical reducing conditions in the soil. Manure applications did not consistently affect corn concentrations of Fe and Cu and uptake of Fe, Zn, and Cu, but were shown to increase the availability of Zn and Mn in the soil studied. Soil cores taken from plots that had received 2 years of beef-feedlot lagoon water contained increased DTPA extractable Fe, Zn, and Mn; Cu was unaffected. Uptake by corn forage of Fe, Mn, and Cu followed yield curves most years. Lagoon water effectively increased the availability of Fe and Mn in the soil studied. Beef-feedlot wastes were shown to be sources of the trace elements Fe, Zn, and Mn. (Rowe-East Central)

### 3402 - B2, B5, C2, D3, F1

### METHANE PRODUCTION FROM ANIMAL WASTES II - PROCESS STABILITY,

Department of Civil Engineering, University of Manitoba, Winnepeg, Manitoba, Canada R3T 2N2
E. J. Kroeker, H. M. Lapp, D. D. Schulte, J. D. Haliburton, and A. B. Sparling
Presented at the 1976 Annual Meeting, Canadian Society of Agricultural Engineering, Halifax, Nova Scotia, July 4-8, 1976, Paper No. 76-208, 15 p. 2 tab, 17 ref.

Descriptors: Methane, Pilot plants, Feasibility studies, Anaerobic digestion, Slurries, Ammonia, Economics, Design, Chemical properties.
Identifiers: Animal wastes, Swine.

Pilot-plant experiments to determine the technical and economical feasibility of anaerobic digestion of swine manure have consistently achieved extreme process stability. Despite periodic environmental shocks, including rapid temperature and loading-rate changes, digestion has never been impaired. In addition, ammonia-nitrogen concentrations have consistently been outside the range considered safe for anaerobic digestion. Laboratory experiments were conducted to test an hypothesis which explained the mechanism of process stability and related it to the high concentrations of ammonia in the manure slurry. (Kroeker, et. al. - University of Manitoba)

### 3403 - A8, A11, B1, C2, E2

### ANIMAL WASTE MANAGEMENT IN THE NORTHERN GREAT PLAINS,

Water Resources Institute, South Dakota State University, Brookings 57006
M. L. Horton, J. L. Wiersma, and J. L. Halbeisen
Environmental Protection Agency Report No. EPA-600/2-76-188, September, 1976, 83 p. 7 fig, 45 tab, 26 ref.

Descriptors: Salinity, Salts, Rations, Cattle, Feedlots, Crop response, Performance, Nutrients, Cations, Sodium.
Identifiers: Northern Great Plains, Land Application, Application rates.

The effect of salt level of the ration for beef steers upon salinity of the waste and the effects of the applied waste upon the soil and upon crop production was investigated. In addition, the study was conducted in both covered and open feedlot pens to study the effect of shelter in a northern climate upon animal performance and waste characteristics. The field portion of the study included 4 rates of waste up to 179 MT/ha. applied to plots 0.02 ha. in size. Detailed soil analyses were made which included salinity, nutrients, cations, and the dispersion hazard as indicated by the level of exchangeable sodium. The levels of salt used in the ration appeared to have little or no effect on animal performance; however, the salinity and sodium levels of the waste were directly affected. The salinity level of the surface 30 cm of soil where high rates of waste were applied was sufficiently high to affect the growth of corn. The lack of leaching water caused a maximum effect of the applied waste in the surface layer. (Horton, et. al. - South Dakota State University)

### 3404 - B1, B2, B3, B4, C1, C2, D1, D2, E2

### PIG SLURRY TREATMENT BY SEPARATION, HIGH RATE FILTRATION AND SLUDGE DEWATERING,

Farm Buildings Department, National Institute of Agricultural Engineering
L. E. Osborne, R. Q. Hepherd, and R. W. Sneath
Water Pollution Control, Vol. 74, Part 5, p. 597-606, 1975. 9 fig, 6 tab, 5 ref.

Descriptors: Slurries, Separation techniques, Filtration, Sludge, Dewatering, Waste treatment, Liquid wastes, Solid wastes, Temperature, Chemical properties, Physical properties, Performance, Flocculation.
Identifiers: Land disposal, Swine, Aluminum chlorohydrate.

A treatment system utilizing separation, high rate filtration and sludge dewatering for treating pig slurry is described. The effects of temperature on the performance of the system is examined. The system reduced the amount of liquid for disposal to about 30 percent of the volume produced by the animal. This liquid was low in suspended solids, allowing it to be as easily pumped and stored as water. The solids resulting from the system were fibers from the separator and dewatered sludge. Both solids and liquids had little odor, were easy to store, and could be applied to land at the optimum time for utilization of plant nutrients. Separation of the raw slurry enhanced pump life and permitted the operation of high rate filters without blocking. After flocculation through use of aluminum chlorohydrate, the sludge was dewatered by gravity in straw bale compounds of hessian-lined pallet boxes. The complete system was automatic. It required less than 1 man hour/day and could be operated by a competent farm worker. As part of the complete system, operation of high rate filters running at mean temperatures of 17·3 degrees C and 5·7 degrees C had similar performances when judged on effluent quality. When considered alone, the heated tower removed about twice as much soluble BOD as the ambient tower. The installation of a high rate filter in a piggery or the heating of the filter by using exhaust ventilation air from the piggery would be worthwhile, if only to avoid freezing. (Rowe-East Central)

### 3405 - A11, B1, E2, E3, F1

### A GROWING SUCCESS IN CATTLE FEEDING,

Calf News, Vol. 14, No. 10, p. 20, 22, 42, October, 1976. 8 fig.

Descriptors: Confinement pens, Recycling, Cattle, Economics, Fertilizers.
Identifiers: Farmers' Coop Society, Refeeding, Animal health.

The Farmers' Coop Society of Sioux Center, Iowa, has a service of matching farmers owning extra cattle to feed with farmers owning extra pen space. This led to the construction of 2 large confinement barns, each capable of holding 2500 cattle. Members of the Coop Confinement Feedlot, who must also be members of the Farmers' Coop Society, own the 30 pens in each barn. One person can own up to 6 pens, and can grow or finish his own cattle, or rent his pens to someone else. The operation has been so successful, that 2 more barns have been added. Each barn has 3 gutters 8 inches wide and 10 inches deep in a "u" shape. The slope of the barn floor is half of one percent and the cattle work the manure down to the flume and water flushes it down and out to a recycling shed. A recycling unit separates out the solids which are used for refeeding, and the water is reused to flush down the flumes. Excess water is used as fertilizer. A recent group of 80 cattle weighing 575 pounds was fed the recycled manure at 50 percent of their ration and in 90 days moved out of the growing pen weighing 814 pounds. The final cost of feed was only 35 cents/pound of gain. The Farmers' Coop Society also has an interesting arrangement with their veterinarian. The veterinarian gets half a cent/head/day and in return does the following: (1) vaccinates all cattle, (2) takes an egg count of the manure, (3) worms the cattle, if necessary, (4) if an animal dies, he gives the owner a post mortem report, and (5) the veterinarian walks through each pen once a week. The veterinarian gets 20 percent over his cost for drugs used. One agreement now in force among the members is that the Coop's nutritionist has the discretion over rations. At present, the death loss in this condominium is three-tenths of one percent. (Edwards-East Central)

### 3406 - B1, B2

### LAST MINUTE LEGISLATION HELPS SWINE PRODUCERS,

Wallaces Farmer, Vol. 101, No. 12, p. 9, June 26, 1976.

Descriptors: Legal aspects, Iowa, Regulations, Zoning, Feedlots.
Identifiers: Nuisance suits, Swine.

In addition to passing a $100,000 appropriation to study pseudorabies, the Iowa legislature has passed a bill which gives livestock producers some protection against nuisance suits and rapid changes in state environmental and zoning regulations. This bill protects livestock producers against suits by people who move in near facilities which have already been built; however, the bill does not protect livestock producers who are sued by people who were there before the facility was built. The bill protects livestock producers against changes in Iowa Department of Environmental Quality rules for 10 years. Plus, it protects against zoning changes for the same length of time from date of construction of facilities that meet current requirements. Some producers and lenders have been worried that changes in Department of Environmental Quality regulations might make confinement facilities and waste handling systems obsolete. (Edwards-East Central)

### 3407 - A11, B1, B3, D3, E3

### PRODUCERS DISCUSS REFEEDING ANIMAL WASTES,

Anonymous
Calf News, Vol. 14, No. 10, p. 57, October, 1976.

Descriptors: Recycling, Fertilizers, Economics, Rations, Litters, Performance.
Identifiers: Refeeding, Animal wastes.

At the annual meeting of the American Society of Animal Science at Texas A&M University, Russell May of Timberville, Virginia, and Sam D. Hay, Jr., of Covington, Georgia, talked about their refeeding operations. May runs an angus herd along with swine, poultry, and sheep. He talked about the use of poultry litter in rations for his herd. Early rations consisted of one pound of corn meal and 3 pounds of litter, supplemented with hay during winter months. Now May mixes corn silage along with the litter and his herd receives a ration of 25 percent litter and 75 percent silage. He piles up the litter for 4 to 6 weeks to allow it to go through a heating period before he uses it. Mr. Hay recycles manure by using a ration consisting of 45 percent corn, 15 percent corn silage, and 40 percent manure for his backgrounding and cattle finishing operation. The silage and corn are mixed with manure and put into a silo for 10 to 14 days before being fed to the cattle. Hay says that with the above ration, an average daily gain of 2.65 per animal has been realized in the finishing operation. Dr. Arnold Peterson from Sear Co., Elburn, Illinois, talked about a $1.5 million plant at Summerfield, Texas, where manure from feedlots is being processed for use in finishing rations, as well as for fertilizer for home gardens. Peterson said that at a feedlot near his home base, a ration containing 30 percent manure and 70 percent corn silage is being utilized. He contended that 30 to 40 percent is the upper limit for feeding manure. He noted that as a feed and as a fertilizer, manure is valued at about $5 million annually in the United States. (Edwards-East Central)

### 3408 - B1, B2, B3, B4, D1, D2, D3, E2, F1, F4
### SYSTEMS AND COSTS OF HANDLING MANURE FROM DAIRY COWS,

Assistant Farm Manager at R. and J. Findlay Ltd.
Easter Cadder, Kirkintilloch, Glasgow, Scotland
R. G. Cason and J. T. McAuslan
Farm Management Review, No. 2, June, 1973, 24 p. 2 fig, 8 tab, 8 ref.

Descriptors: Dairy industry, Economics, Design, Waste storage, Costs, Waste disposal, Solid wastes, Liquid wastes, Equipment, Drying.
Identifiers: Waste management, Housing systems, Cowsheds, Cubicle housing, Strawed cattle courts, Bedding, Cleaning, Land spreading.

The economic principles, costs and physical factors relevant to the choice of manure handling systems for cowsheds, cubicle housing and strawed cattle courts are investigated. The various handling systems which can be used with each type of housing are outlined. The systems are compared on a cost per cow basis. Only costs associated with manure handling are included. The following items have been costed: (1) buildings — alterations of additions necessary to accommodate the manure handling system; (2) storage — construction costs, equipment and materials for storing manure; (3) cleaning, removal to storage and disposal — equipment, labor, power and fuel; and (4) bedding — materials and labor. Of the systems analyzed, minimum handling costs are found in cubicle housing systems with herds over 60 cows. (Rowe-East Central)

### 3409 - C2, D2, E3, F1
### FUELS AND PETROCHEMICALS FROM AGRICULTURAL WASTES,

Texas Tech University, Lubbock, Texas 79409
H. W. Parker and G. A. Whetstone
Paper 5e, presented at the 76th National American Institute of Chemical Engineers Meeting, Tulsa, Oklahoma, March 10-13, 1974, 24 p. 4 tab, 23 ref.

Descriptors: Energy, Recycling, Fuels, Electricity, Economics, Chemical properties, Organic wastes.
Identifiers: Agricultural wastes, Manure, Pyrolysis, Hydrogasification.

It is both more humanitarian and more profitable to utilize arable lands for the production of food and natural fibers than for the growing of plant materials primarily for fuel or bulk petrochemical feedstocks. For this reason only agricultural wastes, which could yield less than one percent of the nation's energy needs, are available for fuels. These agricultural wastes, both manure and plant materials, could potentially be burned in combination with coal for the generation of electricity. Thermochemical processes such as pyrolysis and hydrogasification are technically feasible for agricultural wastes, but the quantities of wastes available in any one vicinity are too small to supply fuel conversion plants of sufficient size to compete with plants processing coal or oil shale. (Parker and Whetstone-Texas Tech University.)

### 3410 - A2, A4, B1, C1, C2
### POLLUTION POTENTIAL OF SNOWMELT RUNOFF FROM AGRICULTURAL FEEDLOTS,

Instructor in Agricultural Engineering, South Dakota State University, Brookings
J. M. Madden and J. N. Dornbush
Presented at the 1970 Annual Meeting, North Central Region, American Society of Agricultural Engineers, North Dakota State University, Fargo, Paper NC70-404, 26 p. 7 fig, 7 tab, 4 ref.

Descriptors: Agricultural runoff, Feedlots, Sampling, South Dakota, Chemical properties, Physical properties.
Identifiers: Snowmelt runoff

A study was initiated in February, 1969, to: (1) determine the quantity and quality of runoff from livestock feeding operations in South Dakota, (2) relate the above information by hydrological and geological considerations in order to appraise the overt influence of this runoff on specific beneficial uses of receiving waters, and (3) determine the influence of spring feedlot runoff as occurs in northern climates. Feedlots were selected for study and were instrumented with a Type H flume and a continuous state recorder to determine the quantity of runoff. Runoff quality was determined from samples taken by an automatic self-starting sampler. After each runoff period the runoff volumes were computed and individual samples were composited according to flow and analyzed. Grab samples representing portions of the runoff hydrograph were also analyzed. Samples were analyzed for biochemical oxygen demand, chemical oxygen demand, dissolved and suspended solids, Kjeldahl nitrogen, and total phosphorus. Conclusions drawn from the investigations were: (1) Spring runoff from livestock feeding operations contains high concentrations of total and suspended solids, plant nutrients, and oxygen demanding material. (2) An empirical relationship considering the animal density, feedlot area, and the depth of runoff can be used to estimate the quantity of pollutional constituents removed during spring runoff. (3) Suspended solids represent a significant portion of the waste concentrations, and detention facilities which provide removal of solids will significantly reduce the pollution potential. (4) Pollution potential is highest from: a series of small runoff events in comparison to one large event, a number of small feedlots as compared to one large feedlot, and a feedlot having a small animal density as compared to one having a high animal density. (Merryman-East Central)

### 3411 - B2, E2, F1
### MACHINERY REPORT. . .CENTER-PIVOT FOR LIVESTOCK WASTE INTRODUCED.

Anonymous
Nebraska Farmer, Vol. 118, No. 20, p. 40, October 16, 1976. 1 fig.

Descriptors: Irrigation, Equipment, Liquid wastes, Waste disposal, Temperature, Costs.
Identifiers: Land spreading.

Valmont's "Valley Water and Waste Irrigation System" was designed for applying liquid livestock wastes directly on the field from pit, holding pond, or lagoon. This stub center-pivot system carries volume guns in place of the sprinkler heads found on the company's conventional center-pivot sprinkler systems. Each volume gun has a 0.6-inch orifice which permits application of liquid wastes with 5 percent solids or slightly higher. Wastes are applied uniformly throughout the area covered by the system. The waste system is electrically driven. It can be operated off either 460-volt or 220-volt electric service. The company offers a portable alternative unit with matched one-cylinder diesel engine to generate electricity to the waste system tower motor. Among benefits Valmont officials list for utilizing wastes through application with this system are the following: (1) Only a limited amount of labor is needed to remove livestock wastes and get them on fields, (2) Spreading can be done whenever temperature is 40 degrees F or higher and the ground isn't frozen, (3) The system provides the dual purpose of irrigation and waste disposal, and (4) Water does the incorporating, making tillage for incorporation of wastes unnecessary. The 10.4-acre Water and Waste Irrigation System will cost somewhere around $9,000 to $10,000, excluding the portable engine-alternator unit. Additional equipment needed includes slurry pump unit and conveyance pipe to the system. (Rowe-East Central)

### 3412 - B2, C2, E2, F1
### USE FEED TO FIGURE HOG WASTE VALUE,

Anonymous
Wallaces Farmer, Vol. 101, No. 5, p. 58, March 13, 1976.

Descriptors: Fertilizers, Nitrogen, Liquid wastes, Economics, Sludge.
Identifiers: Swine, Land spreading.

Amount of fertilizer you get from hog waste depends mainly on how much feed the hog eats and how much it absorbs. Feed that isn't absorbed comes out the other end for fertilizer use. Knowing how much waste goes into the pit can tell you how much you have available to spread for fertilizer. You get about 8.2 lb. of N, 7.6 lb. of $P_2O_5$ and 5.3 lb. of $K_2O$ for every 220-lb hog marketed. Total fertilizer value is computed at $3.01 per 220-lb hog. No $P_2O_5$ of $K_2O$ should be lost in moving the wastes or in the field if there is no runoff. But the wastes should be stirred before being taken to the field. $P_2O_5$ is often tied up in the sludge at the bottom of the pit. $K_2O$ is usually in the liquid floating at the top of the pit. Stirring waste before you handle it will give a more uniform fertilizer treatment. (Rowe-East Central)

### 3413 - A6, B2, B4, D3
### THE EFFECT OF ANAEROBIC DIGESTION UPON SWINE MANURE ODORS,

Department of Agricultural Engineering, University of Manitoba, Winnipeg, Manitoba, Canada R2T 2N2
F. W. Welsh, D. D. Schulte, E. J. Kroeker, and H. M. Lapp
Presented at the 1976 Annual Meeting, Canadian Society of Agricultural Engineering, Halifax, Nova Scotia, July 4-8, 1976, Paper No. 76-206, 16 p. 3 fig, 4 tab, 15 ref.

Descriptors: Odor, Anaerobic digestion, Sampling, Waste storage, Waste treatment, Temperature.
Identifiers: Odor panels, Swine manure, Retention time, Agitation.

A series of odor panels were established to determine the effect of anaerobic digestion on the odor of swine manure. Samples from digesters operated at various solids retention times, agitation rates, and operating temperatures were tested. Anaerobically digested manure that had been stored for various periods of time and undigested manure samples were also tested. Odor ratings demonstrated that: (1) anaerobic digestion brings about substantial and statistically significant reduction in odors from swine manure; (2) the most effective odor reduction through anaerobic digestion occurs at or beyond a 12 day solids retention time; (3) anaerobic digestion at 35 degrees C is more effective than that at 25 degrees C from an odor-control viewpoint; (4) increased agitation can improve the odor control capability of anaerobic digesters at solids retention times of less than 12 days; (5) odors emanating from anaerobically digested swine manure in storage were reduced from that of undigested manure in storage for storage periods as long as one month and possibly as much as two to three months, and (6) although the odors from anaerobically digested swine manure were considerably reduced in presence and offensiveness, they were still identifiable as manure odors having negative qualities. (Rowe-East Central)

### 3414 - A2, B2, E1, E2
### MODELING THE PERFORMANCE OF FEEDLOT-RUNOFF-CONTROL FACILITIES,

Assistant Professor, Agricultural Engineering Department, Kansas State University, Manhattan
J. K. Koelliker, H. L. Manges, and R. I. Lipper
Transactions of ASAE, Vol. 18, No. 6, p. 1118-1121, November-December, 1975. 2 fig, 3 tab, 9 ref.

Descriptors: Agricultural runoff, Feedlots, Watersheds, Model studies, Kansas, Fertilizers, Irrigation.
Identifiers: Runoff control.

A watershed model including a feedlot surface, runoff control structure, and runoff disposal system was developed to help estimate: (a) the percentage of total runoff controlled, (b) conditions under which facilities will overflow, (c) additional requirements to eliminate overflow or limit overflow to prescribed amounts or situations and (d) other sizes of facilities and management alternatives that would allow adequate control with varying intensities of management or that would allow utilization of feedlot runoff for irrigation and fertilizer. The model was used to determine daily runoff evaporation from the structure, precipitation onto the structure, overflow, amount disposed, and volume of runoff in the structure. In Kansas, runoff-control structures sized to contain the volume of a 10-year, or 25-year, 24-hr precipitation event from a feedlot and dispose of 10 percent of the volume per disposal day would control from 91.3 to 99.4 and 93.0 to 100.0 percent, respectively, of all runoff from an unsurfaced feedlot at locations from east to west across the state. About one-third of the average annual precipitation in Kansas is expected to run off an unsurfaced feedlot while about 44 percent is expected to run off a surfaced lot. Based on results from the watershed model presented, evaporation pond sizes in Kansas (to provide control as good or better than land disposal systems) would be 6 ft deep for a surface area 120 percent of the minimum surface area and 4 ft. deep for a surface area 150 percent of the minimum surface area. (Rowe-East Central)

## 3415 - B5, C1, D1, D3

### FIBROUS MATERIAL IN FEEDLOT WASTE FERMENTED BY TRICHODERMA VIRIDE,

Northern Regional Research Laboratory, Agricultural Research Service, Peoria, Illinois 61604
T. Kaneshiro, B. F. Kelson, and J. H. Sloneker
Applied Microbiology, Vol. 30, No. 5, p. 867-878, November, 1975. 2 fig, 1 tab, 5 ref.

Descriptors: Fermentation, Biological treatment, Fungi, Centrifugation, Carbohydrates, Nutrients, Lignins, Cellulose.
Identifiers: Trichoderma viride, Cellulolytic enzymes, Feedlot wastes, Hemicellulose.

A study done by H. L. Griffin, J. H. Sloneker, and G. E. Inglett demonstrated that whole feedlot waste at 2.5 percent concentration is a complete and convenient medium for the production of cellulolytic enzymes by Trichoderma viride. However, higher concentrations were inhibitory to the fungus. This study was performed in an attempt to eliminate this inhibition and improve the overall amount of feedlot waste digestion through fermentation of fibers isolated and compared with whole waste as a fermentation substrate. Isolated fiber different from the whole waste in that no inhibition was detectable at substrate concentrations up to 16.7 percent, but nutrient deficiencies appeared. In all 3 samples, approximately 60 percent of the carbohydrate disappeared and only 68 percent of the solid was recoverable by centrifugation. Lignin content, which is usually 13-30 percent, increased 20-28 percent in the fermentation fibers, and there was a 0.5 and 1.8 percent net increase of insoluble nitrogens. Cellulolytic enzyme production was better with fiber substrates that had been alkali pretreated and had a lower hemicellulose-to-cellulose ratio. (Rowe-East Central)

## 3416 - A4, A5, A7, A8, B1, B4, E2, E3, F2

### FARM WASTES PURIFICATION AND SOLIDS DISPOSAL,

Arnhem, The Netherlands
H. M. J. Scheltinga
Berichte der Abwassertechnischen Vereinigung, Vol. 26, p. 125-131, 1973.

Descriptors: Waste storage, Solid wastes, Liquid wastes, Waste disposal, Air pollution, Water pollution, Land contamination, Groundwater pollution, Fertilizers, Composting, Agricultural runoff, Recycling, Legal aspects, Livestock, Poultry, Europe, Canada, United States, Feedlots.
Identifiers: Guidelines

In Holland and Germany, a comparison of the total water pollution produced by inhabitants, industry, and agriculture yielded a ratio of 1 to 1 to 5. Apart from surface water pollution, farm wastes may cause air pollution, soil pollution and either groundwater or surface water pollution as a result of drainage and runoff. Solid farm wastes, with or without bedding material such as straw, can be used as concentrated fertilizer. They can be stored in the open air without causing high costs or nuisance and can also be transported over long distances. The modern trend in farm design and construction involves the production of semi-liquid wastes, with up to 8 percent dry matter. Recycling must be adopted by modern bio-industries. Three key measures are to be provided: enough land area on which to dispose of the waste; sufficient waste storage capacity; and sufficient distance between livestock and poultry buildings and neighboring human dwellings. In order to institute these measures, two approaches are possible: the legal and the guidelines approach. With respect to water pollution, the legal approach is favored in all the European countries. In Canada and the U.S., the trend is toward the guidelines approach. The Ontario Code of Practice is discussed as a good example of the guidelines approach. It is suggested that if the relationship of animals to acreage were left to the free choice of the farmer, he could be forced to deliver the eventual calculated surplus of manure to a so-called manure exchange. (Solid Wastes Information Retrieval System)

## 3417 - A8, B1, C2, E2

### SOME EFFECTS OF CATTLE DUNG ON SOIL PROPERTIES, PASTURE PRODUCTION, AND NUTRIENT UPTAKE. I. DUNG AS A SOURCE OF PHOSPHORUS,

Ruakura Soil Research Station, Private Bag, Hamilton, New Zealand
C. During and W. C. Weeda
New Zealand Journal of Agricultural Research, Vol. 16, No. 3, p. 423-430, 1973. 2 fig, 7 tab, 14 ref.

Descriptors: Fertilizers, Phosphorus, Crop response, Nutrients, Soil properties.
Identifiers: Application rates, Pasture production, Superphosphate, Cattle dung.

An experiment was performed to measure the effect of cattle dung and of superphosphate on the yield of pasture, nutrient uptake, and on several soil properties during a 3 year period. The trial consisted of 24 treatments replicated 4 times. Initial basal treatments were: 0 — no basal treatment; SP — phosphorus applied in superphosphate at the same rate as in high-phosphorus dung; LD — low-phosphorus dung, collected from cattle grazing unfertilized pasture; HD — high-phosphorus dung, collected from cattle on good pasture. The basal treatments were put down in all combinations with the following annual treatments: Nil — no annual treatments; PK — superphosphate and potassium chloride at 750 and 250 kg ha/per/annum respectively; and P — superphosphate only at 750 kg/ha/annum. It was found that dung, as a source of phosphate for permanent grass-clover pasture on a soil deficient in phosphorus and with high P sorption characteristics, could be equal or even superior to a quick-acting inorganic fertilizer. Dung was found to increase the level of soil organic matter. Soil acidity was reduced. compared with superphosphate applied at equivalent rates of P, cattle dung decreased phosphate sorption and increased soil pH. Recovery of applied phosphate in herbage was higher from dung than from superphosphate. Yield responses of herbage to dung and superphosphate persisted for 2 years and 1½ years respectively. Yields of P were affected for the duration of the experiment. It was found that the area on which dung influenced P uptake was probably about 5 times the area physically covered by it. Hence, under medium stocking rates (3-4 cattle /hectare), the phosphate uptake of established pasture would likely be influenced by dung spots on over half of the grazing area at any one time. (Merryman-East Central)

## 3418 - A11, B1, C2, E2

### FAT NECROSIS IN BEEF CATTLE GRAZING HEAVILY FERTILIZED FESCUE PASTURES,

Animal Scientist and Supervisory Soil Scientist, U.S. Department of Agriculture, Agricultural Research Service, Watkinsville, Georgia
J. A. Stuedemann, D. J. Williams, and S. R. Wilkinson
Presented at Proceedings of the 1974 Beef Cattle Short Course "Winter Management Problems of the Cow and Calf Producer," Cooperative Extension Service, College of Agriculture, University of Georgia, January, 1974, p. 6-8. 6 ref.

Descriptors: Cattle, Fescues, Fertilization, Bermudagrass.
Identifiers: Fat necrosis, Ammonium nitrate, Grass tetany.

Heavy fertilization of fescue pastures has been accompanied by increased animal health problems such as grass tetany and fat necrosis. Fat necrosis is the occurrence of irregularly shaped, hard fat masses primarily in the fat tissue of a cow's abdominal cavity. Lesions of necrotic fat may be found adjacent or attached to digestive tract organs, around the kidneys or in the pelvic area. Visible symptoms of fat necrosis are loss of weight, coupled with listlessness, poor appetite and a rough hair coat. However, these same symptoms are typical of a severe parasite infestation or other problems resulting from poor management. Fat necrosis has not been reported as a herd problem in cattle grazing predominately bermudagrass pastures. No fat necrosis has been observed in monitored herds grazing Coastal bermudagrass over a several-year period at the Southern Piedmont Conservation Research Center, Watkinsville, Georgia. Until the exact cause of fat necrosis has been defined, there will be some uncertainty as to the exact measures required to prevent it. Research at Watkinsville and observation of many farm herds suggest that little or no fat necrosis will develop when the following measures are taken: (1) Limit broiler or poultry litter fertilization of predominately fescue pastures to 4 tons or less/acre/year (dry matter basis). Nitrogen, as commercial fertilizer, should be limited to 200 lb./acre/year. (2) Have a free-choice, complete mineral mixture available to cattle at all times. (3) Stock heavily enough to utilize the grass grown. (4) Use other grasses, particularly bermudagrass, in the grazing system. (Ott-East Central)

## 3419 - B2, B3, B5, C2, D3, E2, E3, F3, F6

### NUTRIENT MANAGEMENT OF CAGED POULTRY WASTE BY THERMOPHILIC AEROBIC DIGESTION,

Department of Agricultural Engineering, South Carolina Agricultural Experiment Station, Clemson University, Clemson, South Carolina
D. T. Hill, and C. L. Barth
Agricultural Engineering Research Series No. 17, Clemson University, September, 1974, 23 pg. 9 fig, 9 ref.

Descriptors: Nutrients, Aerobic treatment, Thermophilic bacteria, Nitrogen, Ammonia.
Identifiers: Refeeding, Land application.

Specific research objectives were: (1) to investigate the feasibility of controlling the form of nitrogen in aerobic biological processes, (2) to establish the degree of nitrogen loss from aerobic biological processes when operated under conditions to promote nitrate formation, and (3) to determine the feasibility of using the waste to sustain the biological growth in the thermophilic temperature range (approximately 40 degrees C). Four plexiglass reactors were utilized in the experiments. It was found that ammonium and nitrate content of the liquid portion after settling can be maintained at either high or low levels depending on the operational mode of the process. The sludge, after settling was approximately .11 percent organic nitrogen at the end of a 9 week study. The organic nitrogen was still increasing rapidly at the end of the test, making the sludge a good crude protein source for refeeding. Nitrogen loss was about 80 percent before nitrification under conditions for promotion of ammonia formation. After establishment of nitrification promoting conditions, nitrogen loss increased to about 95 percent of total loaded. It was not feasible to use poultry waste to sustain biological growth in the thermophilic range (approximately 40 degrees C), using this experimental set-up, since no self-sustained temperature rise could be established. Use of the thermophilic process to manage nutrients must be considered impossible, at least when nitrification is desired. It is impossible to conserve the heat liberated and maintain a residual DO at elevated temperatures simultaneously. (Rowe-East Central)

## 3420 - B1, C2, D2, E3, F6

### RESEARCHERS PROVE CATTLE MANURE PRODUCES ETHYLENE,

Anonymous
Eco Systems, Vol. 6, No. 4, p. 5, January, 1976.

Descriptors: Recycling, Feedlots, Byproducts, Ammonia, Ethane, Methane, Waste treatment.
Identifiers: Ethylene, Cattle manure.

Beef cattle manure, long a major pollution problem for the animal feedlot industry, has been found to yield significant amounts of ethylene, an important product derived from petroleum and natural gas. The discovery was made at Texas Tech University. Assuming a realistic value of ten cents per pound for ethylene, a conservative estimate of the value of the ethylene production from manure produced from a 100,000 head feedlot in the Texas high plains alone would be around $1.8 million per year. The objective of continuing research is to optimize the process to increase the yield of ethylene. Evidence to date indicates that the process appears to be economically feasible for large concentrations of feedlots. Engineers suggest that the ethylene production plants be placed at the feedlot because it is easier to ship the gas by pipeline than to transport the manure. (Rowe-East Central)

## 3421 - A2, A4, B2, C1, C2, D1, D3, F1

### BIOLOGICAL TREATMENT OF FEEDLOT RUNOFF,

T. J. McGhee, D. S. Backer and M. V. O'Neal
Journal Water Pollution Control Federation, Vol. 48, No. 1, p. 153-162, January, 1976. 7 fig, 3 tab, 12 ref.

Descriptors: Feedlots, Agricultural runoff, Biological treatment, Water pollution, Aerobic treatment, Liquid wastes, Sedimentation, Costs, Chemical oxygen demand, Biochemical oxygen demand.
Identifiers: Fish kills.

The pollutional strength of feedlot runoff is sufficiently great to require prohibiting its discharge into surface waters. It was felt that aerobic biological treatment of the runoff might be a good means of reducing its pollution characteristics. Extensive laboratory studies of the treatability of settled feedlot runoff were carried out. Then a field installation was constructed at the University of Nebraska Field Laboratory near Mead. The waste originated on beef cattle feedlots 1.33 acres in area, passed through a shallow grit basin, and was retained in an anaerobic holding pond. Settled feedlot runoff was pumped from the holding pond by a variable capacity pump into an effluent weir. After a retention time of 3.4 hours the effluent then went into the sedimentation basin. Here the effluent was retained another 3.4 hours and then it went into the aeration basin, which operated at 1 day retention time. It was found that the system (based on 210 days operation/yr and a 2-day retention time) would treat 38,200 gal/yr. When evaporation from and rainfall on the pond surface at Mead were taken into account, this was equivalent to the average annual runoff from 0.97 acres of feedlot. With an animal density of 200 head/acre and an average residence time of 180 days, this gave a cost of $0.58/animal. Study conclusions were: (1) An aerobic biological treatment system can stabilize the readily degradable organic material in settled feedlot runoff. An effluent BOD5 of less than 30 mg /1 may be attained at a 2-day liquid retention. (2) Design criteria for such a system are similar to those of high-rate activated sludge if the COD of the settled waste is considered to be equivalent to the BOD. (3) The mixed liquor suspended solids concentration in this system may be estimated with sufficient accuracy from the settled sludge volume. (Rowe-East Central)

## 3422 - A11, B3, C1, C2, D1, E3

### RECYCLED DRIED POULTRY MANURE IN CHICK STARTER DIETS,

Department of Poultry Science, University of British Columbia, Vancouver, British Columbia, V6T 1W5, Canada V61
J. Biely and P. Stapleton
British Poultry Science, Vol. 17, No. 1, p. 5-12, January, 1976. 7 tab, 13 ref.

Descriptors: Recycling, Poultry, Diets, Performance, Mortality, Chemical properties.
Identifiers: Refeeding.

This research was concerned with the evaluation of dried poultry manure (DPM) as a substitute for wheat or as a feed ingredient, when incorporated in the diets of chicks up to 3 or 4 weeks of age. In order to obtain a uniform source of DPM, 300 1 day-old chicks were fed on the basal diet for 3 weeks. The chicks were reared in Jamesway electrically heated, raised wire floor, battery brooders in an air-conditioned room. The droppings were combined, dried at a temperature of 45 degrees C for several days and then ground to a fine powder which contained less than 10 percent moisture. The dried manure was incorporated at a level of 0, 5, 10, 15 and 20 percent in a chick starter diet and recycled 4 times. Results showed: (1) There was a linear decrease in body weight and efficiency of food utilization with each percentage increase in DPM. (2) The amount of dried droppings recovered as a percentage of food consumed was proportional to the amount of DPM included in the diet and remained fairly constant during the recycling. (3) Body weights and efficiency of food utilization were substantially the same during the first 3 recycling periods but declined significantly during the fourth period. (4) Mortality was negligible and all chicks appeared healthy and vigorous. (5) Chicks fed on 10 percent DPM in an isocaloric and isonitrogenous diet grew and utilized food as well as those fed on the basal diet; chicks fed on 20 percent DPM did not consume enough to meet their requirements. (Rowe-East Central)

## 3423 - A6, A8, B1, C2, E2

### HOW TO AVOID COMPLAINTS FROM APPLYING MANURE,

Anonymous
Poultry Digest, Vol. 35, No. 416, p. 422, October, 1976.

Descriptors: Nitrogen.
Identifiers: Odor control, Land application.

John M. Sweeten, Animal Waste Management Specialist for Texas A&M University, stated that proper application of liquid and solid poultry manure in such a way as to minimize odors can help avoid pollution complaints. Poultry manure should be applied at such a rate that the available nitrogen (approximately 70 to 90 percent of the total nitrogen) matches the annual soil/plant nitrogen requirement. Disposal sites should be flat to gently sloping and well vegetated. Applications should be made from mid-morning to mid-afternoon. Fields for disposal should always be downwind, rather than upwind, from neighbors. Subsoil injection of liquid manure, using chisel attachments on tank wagons, gives excellent odor control. Sweeten recommended these additional practices to avoid pollution complaints: (1) maintain good general appearances and public relations, (2) good management of waste drinking water, (3) proper disposal of dead fowl, (4) properly locating the facility, and (5) obtain all pollution control permits. (Rowe-East Central)

## 3424 - A2, B2, B4, E1

### PRINCIPLES OF FEEDLOT RUNOFF CONTROL,

Associate Professor, Department of Agricultural Engineering, University of Nebraska, Lincoln
A. F. Butchbaker, and M. C. Paine
NebGuide G 75-214. Cooperative Extension Service, University of Nebraska, 1975, 1976, 4 p. 6 fig.

Descriptors: Feedlots, Management, Design, Agricultural runoff, Diversion, Drainage, Waste disposal.
Identifiers: Runoff control, Debris basin, Detention pond.

Good management of an open feedlot includes control of runoff. The runoff from an open feedlot carries a large amount of organic matter. This organic matter has an oxygen demand that may deplete the oxygen in public streams. Oxygen depletion may cause fish kills. The five principle factors to consider in feedlot runoff control are diversion, drainage, debris basin, detention ponds, and disposal. Diversions should be installed to prevent unpolluted water from running onto the feedlot surface. Drainage of the pens can be accomplished by maintaining the original surface shaping of the pens. A debris basin will reduce the solids reaching a holding pond. The detention pond should temporarily hold the runoff. Final disposal of the runoff can be achieved by returning it to the land or by evaporation. (Rowe-East Central)

## 3425 - A11, E3

### PROCESSED POULTRY WASTE COMPARED WITH URIC ACID, SODIUM URATE, UREA AND BIURET AS NITROGEN SUPPLEMENTS FOR BEEF CATTLE FED FORAGE DIETS,

Ruminant Nutrition Laboratory, Nutrition Institute, Beltsville, Maryland 20705
R. R. Oltjen, and D. A. Dinius
Journal of Animal Science, Vol. 43, No. 1, p. 201-208, July, 1976. 3 fig, 5 tab, 19 ref.

Descriptors: Ureas, Biuret, Cattle, Feeds, Performance, Diets.
Identifiers: Poultry wastes, Uric acid, Sodium urate, Refeeding.

Poultry waste products processed to recover compounds for industrial and medicinal uses were compared with uric acid, sodium urate, urea and biuret as non-protein nitrogen sources for cattle fed forage diets. In a metabolism trial, steers fed 50 percent of their dietary nitrogen from uric acid, sodium urate or a processed poultry waste product (containing 28 percent uric acid) were found to digest dry matter, fiber, and nitrogen equally well. Steers fed poultry waste had greater urinary nitrogen losses and retained less nitrogen than those fed the sodium urate diet. Ruminal fluid pH was not different among treatments. Ruminal fluid ammonia concentration was consistently higher for steers fed poultry waste than for steers fed uric acid or sodium urate. During a 90-day growth trial, steers receiving 40 percent of their dietary nitrogen from 2 processed poultry waste products gained weight faster and more efficiently than steers fed similar dietary percentages of nitrogen from either biuret or urea. Neither the concentration of ruminal fluid volatile fatty acids nor the concentration of plasma free amino acids differed among treatments. Adaptation study results indicated that ruminal microbes could not readily degrade biuret after 14 days of diet adaptation, but after 28 days, ruminal ammonia concentrations averaged 30 percent higher with steers fed biuret than with those fed urea. Study results indicated that the processed poultry wastes tested were similar to uric acid and sodium urate but superior to urea and biuret when used as nitrogen supplements for beef cattle fed forage diets. (Rowe-East Central)

## 3426 - C2

### PROPORTIONS OF AMMONIA, UREA, URATE AND TOTAL NITROGEN IN AVIAN URINE AND QUANTITATIVE METHODS FOR THEIR ANALYSIS ON A SINGLE URINE SAMPLE,

Biology Department, Virginia Polytechnic Institute and State University, Blacksburg, 24061
F. M. McNabb and R. A. McNabb
Poultry Science, Vol. 54, No. 5, p. 1498-1505, September, 1975. 30 ref.

Descriptors: Analysis, Ammonia, Ureas, Urine.
Identifiers: Samples, Urate, Total nitrogen.

The purposes of this study were: (1) to develop a dilution method that would evenly distribute all nitrogen compounds in a solvent and (2) to modify existing analytical methods for ammonia ($NH_3$), urea, urate (UA) and total nitrogen to permit determination of all these nitrogen compounds on aliquots of the same diluted urine sample. After this system was developed, stored samples of rooster urine collected during a study by Ward et. al. (1975) were analyzed to extend information on the proportions of nitrogeneous distribution of all nitrogen compounds (including those in the original precipitate) and performing this step in an ice bath prevented $NH_3$ loss from the alkaline mixture. This permitted determination of total nitrogen on an aliquot of diluted urine identical to those used for other analyses, thereby permitting determination of an unknown-N fraction not included in UA, $NH_3$. or urea. Accuracy and precision of these methods were very good. The proportions of urinary nitrogen found were: uric acid — 55-72 percent; ammonia — 11-21 percent; and urea — 2-11 percent. This ranking of proportions was consistent for 4 different dietary protein-water availability regimes. No significant differences in the proportions of these nitrogenous compounds due to either dietary protein intake or changes in water availability were found. (Rowe-East Central)

## 3427 - A6, A7, A10, A11, A13, B1, C1, C3, D1, D2, D3, E2, E3

### RESEARCH ON POULTRY WASTE IN THE UNITED STATES,

Cooperative State Research Service, U.S. Department of Agriculture, Washington, D.C. 20250
W. E. Shaklee
World's Poultry Science Journal, Vol. 20, No. 4, p. 323-344, 1973. 104 ref.

Descriptors: Research and development, Recycling, Waste treatment, Waste disposal, Odor, Dusts, Aesthetics.
Identifiers: Poultry wastes, Flies.

The effects of poultry waste on the environment have received much attention in recent years in the United States. With the development of relatively inexpensive commercial fertilizers, poultry waste is no longer needed for soil enrichment. Greater concentration of poultry and egg producing units has resulted in large amounts of waste products near large population centers with limited areas of open land available for disposal. More and more neighbors are complaining about odors, flies, dust, and unsightly manure accumulations associated with poultry producing units. As a result of such animal waste disposal problems, regional research, funded by appropriations under the Hatch Act, has been conducted in an effort to better understand and manage animal wastes. Research projects that are being conducted in the United States on the handling of poultry waste are outlined for 45 different institutions. The research has pointed to several solutions for poultry waste problems. Incorporation into the soil is still one of the most satisfactory methods of handling waste if enough land is available. Much of the research is geared toward reducing disagreeable aspects of poultry waste by minimizing odors, flies, dust and other debris. Other research is designed for processing the waste into useful products. (Rowe-East Central)

## 3428 - B3, C2, D3, E2, E3, F1

### FROM RAW MANURE TO FERTILIZER IN 50 DAYS,

Associate Editor, Nebraska Farmer
N. Effertz
Nebraska Farmer, Vol. 118, No. 20, p. 9, 10, and 14, October 16, 1976. 4 fig.

Descriptors: Fertilizers, Feedlots, Costs.
Identifiers: Composting.

The Schliz-McGinley feedlot at Brule cleans its lots and hauls its manure to a composting site at one edge of the feedlot where a Sterling, Colorado company composts the manure for the feedlot. The company charges $12.50 per ton for composting the wastes, but the feedlot has found this charge worthwhile. The composting cuts the manure volume in half. The compost has a nitrogen fertilizer value 15-20 times that of raw manure on an available nitrogen basis. Application rates are much less and the concentrated form of the compost lets them cut their spreading time by about 75 percent. The compost can be stockpiled for more than a year, so there is no waiting until fields dry out for spreading before they can clean the pens. The composting technique employed by the composting company involves these steps: (1) Manure is placed in 5-foot high by 10-foot wide windrows. (2) A special bacterial culture is added to the windrows as a machine custom-designed for the compost corporation passes over the windrows, grinding and aerating the manure. (3) Bacteria multiply and the windrow material heats to about 140 degrees F., killing all disease organisms and weed seeds. (4) The bacteria continue to break down the organic matter which is machine-aerated every 3-6 days. In 6-8 weeks, the fermentation process is complete and what remains is a 25 percent-moisture, odorless, stable humus resembling coarse-ground potting soil. Whatever of the compost that the feedlot owner doesn't choose to use on his own land may be marketed. (Rowe-East Central)

## 3429 - B1, B4, C2, D3, E3

### METHANE PRODUCTION FROM ANIMAL WASTES. I. FUNDAMENTAL CONSIDERATIONS,

Agricultural Engineering Department, University of Manitoba, Winnipeg, Manitoba, Canada.
H. M. Lapp, A. B. Sparling, D. D. Schulte, and L. C. Buchanan
Canadian Agricultural Engineering, Vol. 17, No. 2, p. 97-102, December, 1975. 6 tab, 19 ref.

Descriptors: Methane, Biological treatment, Recycling, Anaerobic digestors, Chemical properties, Waste storage, Safety.

Anaerobic digestion, a complex biological process, is dependent upon nutrient balance in the feed material, loading rate, retention times, temperature, alkalinity and pH, volatile acid concentration, total solids, concentration, and degree of mixing for successful operation. These factors and their influences are being monitored in a pilot plant at the University of Manitoba where 4 digestors are being fed hog wastes. Digester gas contains 60-70 percent methane, 30-40 percent carbon dioxide, small amounts of hydrogen sulfide, and traces of additional gases such as ammonia, hydrogen, and oxides of nitrogen. Methane is known as a "permanent gas" because it cannot be liquified by pressure at ordinary temperatures. This property presents a unique storage problem, particularly for use in mobile power units. Procedures for handling, purification and placing the methane into storage must be established for successful production and utilization of this gas on farms. Safety precautions must be observed during the production and utilization of the gas, since methane is explosive when combined with air in ratios ranging from 5 to 15 percent. (Rowe-East Central)

## 3430 - A11, B3, C2, E3

### VALUE OF RECYCLED MANURE QUESTIONED,

Anonymous
Western Livestock Journal, Vol. 54, No. 29, p. 11, April 12, 1976.

Descriptors: Recycling, Nutrients, Cattle, Performance, Minerals, Toxicity.
Identifiers: Refeeding, Digestibility.

Two University of California scientists have been studying recycling manure as a cattle feed. Most feedlot manure contains 12-18 percent crude protein. It is also relatively high in carbohydrates which the rumen can digest and has important minerals such as calcium and phosphorus. While the chemical analysis doesn't look too bad, the manure has been found to be essentially a poor quality roughage with high nitrogen content. Digestibility is low. It is hard to get livestock to eat the manure and about 80 percent of what they do eat becomes manure again. University of California scientist W. M. Garrett and former graduate student C. L. Ferrell conducted a study to see if concentrations of certain minerals in manure that might be harmful increased each time the manure was recycled. They concluded that continued recycling increased the calcium, copper and magnesium concentrations in the dried excreta, but that the increases were not sufficient to be harmful. In another study, University of California scientist J. L. Hull and some fellow researchers supplemented 2 groups of pregnant beef cows on dry native range with either pelleted cottonseed meal or a pelleted mixture of 75 percent feedlot manure and 25 percent barley for 84 days. A third group received no supplementation. The study revealed that manure in combination with barley may be fed as a supplement to pregnant cows as an alternative to high quality protein supplements such as cottonseed meal. Based on research as a whole, however, the scientists found the use of manure as a feed to be marginal at best. (Rowe-East Central)

## 3431 - B2, C2, D3

### MODELING SHORT-TERM MINIMUM AEROBIC PROCESSING OF SWINE MANURE,

Engineering Research Service, Research Branch, Agriculture Canada, Ottawa, Ontario, Canada.
P. A. Phillips and J. R. Ogilvie
Canadian Agricultural Engineering, Vol. 16, No. 2, p. 86-90, December, 1974. 3 fig, 2 tab, 13 ref.

Descriptors: Model studies, Waste treatment, Aeration, Chemical oxygen demand, Liquid wastes.
Identifiers: Swine manure, Dilution rates, Flow rates.

A short-term minimum aeration cintinuous culture treatment for swine manure—was designed on a laboratory scale. The model was tested at 3 levels of dilution rate and 3 levels of flow rate to determine the effects of these paratmeters on soluble chemical oxygen demand. It was found that measuring change in mixed liquor chemical oxygen demand during batch culture aeration offered a rapid measurement from which necessary oxygen requirements of swine manure could be derived. Using a fixed aeration device, no significant effect of flow rate or detention time on reduction in soluble chemical oxygen demand was observed while varying the oxygen demand of the manure on the short-term minimum aeration processing system. The calculated oxygen demands ranged from about one-half to twice the oxygenation capacity of the aerator (as determined in clean water). Detention time had an effect ($P = 0.9$) on reduction of total chemical oxygen demand. Flow rate had no effect on total chemical oxygen demand reduction. Analysis of covariance indicated that variation of influent-soluble chemical oxygen demand from about 10,000 to 18,000 mg/liter had no effect on effluent-soluble chemical oxygen demand concentration from the short-term minimum aeration processing system. Variation in influent-soluble chemical oxygen demand significantly affected reduction in total mixed liquor chemical oxygen demand. The size of the model tested may be increased 100 percent or more, but it should be emphasized that the model results may be subject to unknown effects of scale. (Rowe-East Central)

## 3432 - A11, B3, C1, C2, C3, D2, D3, E3, F1

### REFEEDING SEMINAR BRINGS HOPE FOR LOW-COST FEEDING,

Anonymous
Calf News, Vol. 14, No. 9, p. 46-47, September, 1976. 4 fig.

Descriptors: Litters, Performance, Physical properties, Chemical properties, Biological properties, Costs.
Identifiers: Refeeding, Poultry wastes, Ensiling, Manure.

A Waste Management and Recycling Seminar was held in July by Texas Grazon of Amarillo, Texas, to give feeders a chance to hear from experienced men on the subject of refeeding manure and poultry litter. Dr. W. B. Anthony of Auburn University said that his research has convinced him that blending animal waste with other ingredients and ensiling the combination is the best use of the product. Anthony stated that manure should be left in the silo for at least 10 days with at least 35 percent moisture. Everett Hatfield of the University of Illinois showed data which demonstrated that when waste was used as 10 percent of the ration, conversion was improved and gain was no different. No significant difference in the rate of gain or efficiency was found when Hatfield substituted poultry litter for all the minerals, all the nonprotein nitrogen and part of the roughage. Dr. Gene Masters, president of Master's Agri-Consultants, Athena, Georgia, has been successfully feeding 3,000 cattle a ration with 10 percent grain, 20 percent candy wastes, and 70 percent broiler litter. Another feeder, Sam Hay, Jr., from Covington, Georgia uses 45 percent cracked corn, 15 percent silage and 40 percent manure. This ration is put in an upright silo for 10 days. Walter Paetzold, owner-manager of Western Feedlot of Herford, Texas, uses poultry and cage droppings instead of cattle manure. Manure collecting was a problem because his lot is located on caliche hills. Paetzold purchases poultry and cage droppings for nine dollars a ton at 40-50 percent moisture. (Edwards-East Central)

## 3433 - A2, A10, B2, D3, E2

### THEIR LOW COST MANURE SYSTEMS ARE DOING THE JOB,

R. E. Marcoot and W. R. Bock
Hoard's Dairyman, Vol. 121, No. 18, p. 1056, September 25, 1976. 2 fig.

Descriptors: Dairy industry, Feedlots, Lagoons, Costs, Irrigation, Anaerobic conditions.

Since much of the soil in southwest Missouri is not suited to cash crops, the area is largely dairy oriented. For dairymen whose herds do not exceed 30-40 cows, handling manure has not been a problem; however, dairymen with larger herds have turned to semidrylot systems in which runoff is channeled into lagoons. To determine the volume of an anaerobic lagoon, one must figure the amount of manure and lot runoff. Amount of manure is determined by: (1) number of cows, (2) time they are in the lots, and (3) percent of manure from lots that is placed in the lagoon. Amount of lot runoff is determined by: (1) lot size, and (2) annual rainfall. In a lagoon, bacterial action breaks down the solids into small particles which can remain in suspension. This effluent can be distributed onto the land during dry periods through an irrigation system. A small irrigation system will deliver an acre inch of effluent in a little over an hour. Anaerobic lagoons with a 2 percent slope have been most economical for construction costs. The push off ramp on a lagoon is another cost item. Designed so that wastes can be deposited in at least 4 feet of water, these reinforced concrete ramps vary in costs from $400 to $1,000. Lagoons in southwest Missouri have been built with the following objectives in mind: (1) keep cows clean, (2) cut labor needs, (3) control flies, (4) save plant nutrients, and (5) control pollution for the least investment. Cows are kept cleaner because the manure can be pushed into the lagoon when field conditions are unfavorable for hauling. Labor requirements are reduced because it is faster and easier to use an irrigation system for hauling manure. Breeding areas for flies are eliminated when the manure is stored in a lagoon. (Edwards-East Central)

## 3434 - A2, A4, C2, C3

### RIVER POLLUTION BY FEEDLOT RUNOFF,

Kansas State Teachers College, Emporia
C. W. Prophet
Conservation Proceedings of the Oklahoma Academy of Science for 1967, Vol. 48, p. 207-209. 1 ref.

Descriptors: Water pollution, Agricultural runoff, Feedlots, Kansas, Ammonia, Coliforms, Dissolved oxygen.
Identifers: Cottonwood River, Fish kills.

The purpose of this study was to draw attention to the problem of feedlot runoff and to report on a preliminary study concerning its effect on the Cottonwood River in the vicinity of Emporia, Kansas. If relatively large numbers of cattle are concentrated into a river or stream, large quantities of organics may be introduced. The amount of contamination will vary depending upon the number of cattle present, the amount of accumulated wastes, and the precipitation. To date, the most evident result of the introduction of feedlot runoff into the Cottonwood River has been fish kills. Adverse river conditions created by the feedlot runoff include decreased dissolved oxygen, increased ammonia, and increased fecal coliform bacteria. During the absence of runoff, dissolved oxygen at all points in the study tended to exceed 4 ppm, ammonia was generally less than one ppm, and fecal coliform bacteria rarely exceeded 1000 cells per 100 ml. Following runoff, ammonia was frequently greater than 10 ppm and dissolved oxygen was decreased. The fecal coliform counts rose whenever there was runoff. (Rowe-East Central)

## 3435 - C2, D3, E3, F1

### STORAGE A PROBLEM FOR "BIO-GAS" USE,

Anonymous
Nebraska Farmer, Vol. 118, No. 10, p. 23, May 15, 1976.

Descriptors: Recycling, Methane, Fuels, Waste storage, Economics.
Identifiers: Anaerobic digester.

Methane or "bio gas" may be produced in an anaerobic digester when manure in the digester is broken down by bacteria. Ralph W. Hansen, Colorado State University Extension Agricultural Engineer, says that manure from 50 cows would produce enough methane gas each day to heat a well-insulated three bedroom home during the winter. Since this gas cannot be liquified under normal temperatures, it is best suited for stationary uses such as cooking and heating. Because of the high compression needed to get enough bio gas on a tractor to run it, a serious safety hazard would be created if it were used in this manner. Bio gas has a heat value of 500-600 Btus per cubic foot as compared with natural gas, which has a heat value of 1,000 Btus per cubic foot, and gasoline, which has a heat value of 124,000 Btus per gallon. Hanson said that out of the several types of energy capturing processes available, the production of bio gas appears to be the most feasible for most agricultural operations. He lists the main disadvantages as: (1) amount of management required due to the sensitivity of the digesters, (2) high initial investment for equipment, and (3) wastes still must be disposed of after digestion. Attempts are being made to find new strains of bacteria and culturing techniques for producing this gas, and also to find designs which will reduce the costs and make it more practical. (Edwards-East Central)

## 3436 - A11, B1

### STILL TIME TO BUILD FEEDLOT MOUNDS,

Anonymous
Wallaces Farmer, Vol. 101, No. 20, p. 4, October 25, 1976.

Descriptors: Feedlots, Cattle, Design, Management.
Identifiers: Mounds.

Tips are given for planning and constructing a feedlot mound that will keep cattle out of mud during the winter. The tips are: (1) Locate mound close to feedbunk slab so cattle can get from mound to the bunk without crossing a mudhole. (2) Build mound parallel with general lot drainage. (3) Mounds should be 5-8 feet high. (4) Slope the mound as steeply as possible while still allowing cattle to rest comfortably. (5) Crown the mound for good drainage. If the top is left flat, pockets develop where water will stand. Keeping the top fairly narrow helps too. (6) To stabilize the mound, use good firm soil, preferably clay. (7) Covering the mound with bedding helps protect the mound surface and insulates the animal's body from the frozen ground. (Merryman-East Central)

## 3437 - A8, B1, E2

### HEAVY MANURING HURTS YIELDS ON DRY SOIL,

Anonymous
Wallaces Farmer, Vol. 101, No. 20, p. 4, October 25, 1976.

Descriptors: Salts, Rainfall, South Dakota, Crop response, Soil sealants, Infiltration.
Identifiers: Land application, Feedlot wastes, Application rates.

Caution should be used in applying excessive animal wastes to soils when there is a lack of sufficient rainfall. South Dakota research found that application of beef feedlot wastes in excess of 20 tons of dry matter/acre in each of 2 consecutive years resulted in large increases of salts within the soil profile. Less than normal rainfall resulted in little or no leaching water, thus increasing salts in the soil and decreasing crop yields. Following those 2 consecutive years, soils receiving greater than 40 tons of waste /acre/year showed a substantial reduction in the ability to infiltrate water. Elimination of the waste treatment for 1 season resulted in increased water infiltration and reduced salinity due to rainfall and weather conditions. Sealing of soil resulting in reduced water infiltration appears to be temporary and can be expected to improve with decay of the applied wastes. (Merryman-East Central)

## 3438 - A8, B3, E1, E2, F3

### LEACHED MANURE - A PROMISING SOIL ANTI-CRUSTANT,

Farm Advisor, Monterey County, California.
D. Ririe
California Agriculture, Vol. 30, No. 9, p. 16-17, September, 1976. 4 tab.

Descriptors: Soil amendments, Crop response, Cattle, Leaching, Irrigation, Waste treatment.
Identifiers: Anti-crustant, Land application, Steer manure

The problem of soil crusting in California has been dealt with by using the following materials: (a) petroleum mulch, (b) stabilized vermiculite, and (c) phosphoric acid; but due to cost, application difficulties, and other reasons, these materials are not always acceptable. Steer manure is being tested as a soil anti-crustant, and when it is leached, it has been found to enhance lettuce seedling emergence under soil crusting conditions. Tests in 1962, where 3- and 10-ton-per-acre applications of chicken manure was tested as a soil anti-crustant, showed no evidence that chicken manure prevented crust formation. In 1964, a test was made in which steer manure was mixed with soil and used to cover lettuce seeds, but no benefit was derived from this method. In 1973, steer manure was leached with water, pulverized, and used to cover lettuce seeds. In this test, it was found that covering the seeds with leached manure greatly improved lettuce emergence. However, this material was still slightly inferior to stabilized vermiculite in all of the evaluation factors except seedling weight. The tests also showed that steer manure used as a seed covering gives results which vary, depending on the amount and frequence of irrigation. Further experiments which appear to be justified include: (1) field-test leached manure, (2) ascertain the amount of leaching necessary, (3) define the irrigation regime necessary for best results, and (4) find a satisfactory mechanical means of applying the material. (Edwards-East Central)

## 3439 - A11, B1
### TEXAS TECH SCIENTIST CITES RATIONS' EFFECT ON WASTE ACCUMULATION,

Anonymous
Feedstuffs, Vol. 43, p. 4, September 25, 1971.

Descriptors: Rations, Cattle, Feedlots, Management, Performance.
Identifiers: Waste accumulation, Roughage.

At the annual meeting of the ASAE in Davis, California, Dr. Robert C. Albin, animal science professor at Texas Tech University in Lubbock, Texas, stated that different rations of feeder steers can affect waste accumulation, without greatly affecting animal performance. Cattle that were fed a zero-percent roughage ration had a waste accumulation of only 2.2 lb daily as compared to cattle fed a 10 percent and 12 percent roughage whose daily wastes ammounted to 4.5 lb. and 5 lb., respectively. Albin said that it isn't practical to feed a zero percent roughage ration for the sole purpose of getting a large waste reduction, but that it is important to realize the practicality of lowering the amount of roughage a small degree to achieve a lower amount of waste accumulation. Rations used in the trials consisted primarily of dry rolled grain sorghum formulated into all concentrate (or no roughage) and the 10 percent and 12 percent roughage finishing rations. Circumstances where no significant differences were found included: (1) different slopes, 7½ percent and 15 percent, which were both concrete surfaces, and (2) shaded and unshaded pens. Differences did occur where there was a variance in animal density. When the amount of sq. ft. per head was changed from 120 sq. ft. to 30 sq. ft., the following reactions developed: (1) lower daily gains, (2) less feed consumption, and (3) reduced efficiency of food utilization. (Edwards-East Central)

## 3440 - A2, A3, A4, B1, F2
### WASTE TREATMENT RULES WON'T PUT "IMPOSSIBLE" BURDENS ON PRODUCERS,

Feedstuffs, Washington editor
J. McClung
Feedstuffs, Vol. 48, No. 31, p. 2, August 2, 1976.

Descriptors: Waste treatment, Feedlots, Agricultural runoff, Legal aspects.
Identifiers: 1972 Federal Water Pollution Control Act, Point sources, Nonpoint sources.

Section 208 of the 1972 Federal Water Pollution Control Act requires beef and other livestock producers to use the best possible management procedures but, according to a panel of EPA and USDA specialists, it will not put an impossible burden on these producers. Section 208 is a program which will attempt to get cooperation among local governments in a particular area to find ways where common water problems, too severe or complex for technology solving alone, can be solved. Pollution factors in a given point may include (1) point and nonpoint sources, (2) industrial-municipal pollutants, and (3) agricultural runoff. In addition to agricultural runoff, this plan will speak to forestry, mining, and construction activities and the intrusion of salt water into groundwater supplies do to the reductions in the flow of fresh water from any cause. The 1972 act works in the following way. Governors of states decide which areas in their state need 208 planning. Then designated areas have an agency created with members which include elected officials from the local governments concerned. These men then plan for waste water treatment. Their goal is to have all the treatment works necessary to maintain acceptable water quality over a 20-year period. Once approved by the EPA, federal funds are available to the planners. To minimize water pollution problems with as little federal involvement as possible is the intent of the 208 program. Because of the few options available to ranchers on waste control, cow-calf operations should not be affected. (Edwards-East Central)

## 3441 - A8, B2, C2, D3, E3
### USE OF SOIL SYSTEM FOR RENOVATION OF EFFLUENT FROM MINIMAL TREATMENT OF SWINE MANURE,

Department of Agricultural Engineering, Macdonald Campus of McGill University, Ste. Anne de Bellevue, Quebec, Canada
A. M. Shady, and J. R. Oglivie
Canadian Agricultural Engineering, Vol. 18, No. 1, p. 10-13, June, 1976. 6 fig, 4 tab, 10 ref.

Descriptors: Effluents, Nitrogen, Aeration, Leaching, Denitrification.
Identifiers: Land application, Swine manure, Odor removal, Soil systems.

Evaluation of the efficiency of the soil systems on nitrogen and odor removal from effluents and minimally treated swine manure were investigated. Soil columns of 60-cm length and 15-cm diameter were used under controlled temperature and humidity. A total of 2.5 cm of liquid effluent containing an equivalent of 610 kg/ha of nitrogen was added in one, two and four applications. A wet schedule was followed during the experiment. Results showed that the application of 600 kg/ha of total nitrogen resulted in nitrate levels of less than 2 mg/liter from soil columns. While the liquid from the minimum-aeration process contained a high level of ammonia, the general offensiveness as rated by an odor panel was low. Although free drainage was provided from the soil columns, a moist layer was formed, and both the dissolved oxygen and redox potential were low at a depth of 50 cm. The yield of nitrate-nitrogen from the columns was very low. Evidently, denitrification was active. Spreading the manure in multiple applications, rather than a single application, further reduced the possibility of nitrate leaching. Odor offensiveness was found to be related to the volume of application. (Rowe-East Central)

## 3442 - A8, B2, C2, E2, F1
### WASHINGTON COUNTY STUDY... HOW HOG WASTES VARY IN THEIR FERTILIZER VALUE,

J. Carlson
Wallaces Farmer, Vol. 101, No. 6, p. 49, March 27, 1976. 1 fig.

Descriptors: Fertilizers, Nutrients, Economics, Waste storage.
Identifiers: Swine wastes, Land application.

Jim Frier, Washington county extension director, discusses the fertilizer value of hog wastes. Fertilizer value of hog manure can be influenced by these factors: type of housing facility, dilution of manure from waterers or rainfall, ration fed, amount of feed wasted, depth of manure pit, and length of manure storage. Separate test samples were taken from 18 manure pits from vacuum tank wagons immediately after loading. The pits had been agitated by recirculating a load back into them before samples were drawn. Hoses were placed on the bottom of the pits. The types of facilities represented were farrowing, nursery, finishing (pits over half full), and finishing (pits less than half full). Average nitrogen, $P_2O_5$ and $K_2O$ for each of the types of facilities in their respective order were: nitrogen — 28.8, 34.5, 56.4, 61.8; $P_2O_5$ — 9.4, 10.4, 20.3, 30.5; $K_2O$ — 11.6, 11.0, 23.7, 29.0. Value of wastes from the farrowing pits was $7.08 100 gal. Nursery pit wastes worth $7.95/gal. Finishing pits over half full had a waste value per 100 gal of $13.60. Wastes from a finishing pit less than half full were worth $16.50 per 100 gal. Much of the fertilizer nutrients in wastes are available to plants the first year. Organic nitrogen, however, yields only 50 percent as available the first year. The rest carries over. Frier cautions that every manure pit is different and sampling is the only way to know what and how much nutrients are available. (Rowe-East Central)

## 3443 - B1
### MODELING THE OPTIMAL LOCATION OF THE CATTLE FEEDING INDUSTRY,

West Virginia College of Graduate Studies
D. L. Byrkett, R. A. Miller and E. P. Taiganides
American Journal of Agricultural Economics, p. 236-244, May, 1976, 192 fig, 5 tab, 13 ref.

Descriptors: Model studies, Feedlots, Cattle, Locating, Linear programming.

A variety of interregional linear programming models have been used to study the optimal location of the cattle feeding industry. An analysis was performed to determine which factors are most influential in determining feedlot location and thus need to be included in these models. In addition to traditional factors, consideration was given to the effects of region definition and regional land use patterns. A new cost minimization linear programming model was developed on this basis. The following results were obtained: (1) Feeder availability and grain availability is not a primary concern in the location of cattle feeding. (2) Roughage availability is not a primary concern in the location of cattle feedlots. (3) Slaughter capacity will influence the location of cattle feeding in the short run, but in the long run slaughter facilities will move to the feedlots. (4) In modeling the location of cattle feeding, it is important to use a greater number of resource regions than cattle feeding regions, (5) Land use patterns that reflect both the competition for land resources and the conflict resulting from efforts to eliminate problems associated with odors, solid waste disposal, and water pollution in areas of high population density is an important factor influencing the location of cattle feeding. (Rowe-East Central)

## 3444 - A2, F6
### MODELING FEEDLOT RUNOFF POLLUTION. II. QUASILINEARIZATION,

Graduate research assistant, Chemical Engineering Department, Kansas State University, Manhattan
S. F. Kang, L. T. Fan, E. W. Lee, and L. E. Erickson
Transactions of the ASAE, Vol. 13, No. 6, p. 864-869, November-December, 1970. 2 fig, 2 tab, 18 ref.

Descriptors: Equations, Model studies, Feedlots, Agricultural runoff.
Identifiers: Quasilinearization.

Estimation of the parameters of a nonlinear model for the feedlot runoff system may be done by the quasilinearization technique. In this work, the parameter estimation problem is treated as a multipoint boundary-value problem in which the resulting set of differential equations of the boundary-value is solved by the quasilinearization technique. The advantages of the quasilinearization technique is that, if the process converges, it converges quadratically. This technique has been proven useful not only in parameter estimation, but also in solving nonlinear boundary value problems in partial and ordinary differential equations. However, the quasilinearization technique also had disadvantages. Two of the most important ones are the ill conditioned problem and convergence problem. (Merryman-East Central)

## 3445 - B2, F6
### RHEOLOGICAL PROPERTIES OF AERATED POULTRY WASTE SLURRIES,

Agricultural Engineer, Agricultural Engineering Department, Cornell University, Ithaca, New York
Y. R. Chen and A. G. Hashimoto
Transactions of the ASAE, Vol. 1[illegible], No. 1, p. 128-133, January-February, 1976. 6 fig, 2 tab, 15 ref.

Descriptors: Slurries, Aeration, Rheology, Equations, Temperature.
Identifiers: Pipeline transport, Shear rate, Shear stress, Volume fraction index.

This study was undertaken to find a master equation for describing the rheological properties of aerated poultry waste slurries under laboratory and field scale treatments. The study revealed aerated poultry waste slurries to be pseudoplastic and a master equation involving shear stress, shear rate, and volume fraction index was developed. For the temperature ans and shear rate range studied, the effect of temperature on the apparent viscosity of aerated poultry waste slurries was negligible. Thus, for the temperature range experienced in the field (10-25 degrees C), temperature effects may be disregarded when estimating apparent viscosities for design purposes. Because data from rotational and capillary tube viscometers were comparable, the results obtained from rotational viscometer studies can be used for designing pipeline transport systems. Further research is needed to correlate the Fanning friction coefficient with the generalized Reynolds number for pipeline transport of livestock slurries under field conditions. (Merryman-East Central)

### 3446 - A6, B1, C2, D2, D3

### SMELL LIKE MONEY...OR PIG MANURE,

Successful Farming, Vol. 74, No. 12, p. 50, November, 1976.

Descriptors: Odor, Management, Waste treatment, Biological treatment, Chemical treatment.
Identifiers: Swine, Odor control.

Probably the most important step in keeping odors within tolerable limits is to select a site for livestock facilities where odors will be less of a problem. Prevailing wind patterns should be checked. Management practices which may be utilized to combat odor problems include: dilution, ventilation, aeration, covering, burning, absorption, adsorption, masking, and filtration. Chemical treatment of wastes can also reduce odors. Hydrated lime reduces production of hydrogen sulfide and carbon dioxide, but increases ammonia liberation and therefore decreases fertilizer value. Chlorine stops bacterial action, reducing odors, but it also stops breakdown of wastes. Both treatments require relatively large amounts of chemicals. (Merryman-East Central)

### 3447 - A11, B3, C2, E3

### TURKEY LITTER SILAGE IN RATIONS FOR DAIRY HEIFERS,

Department of Poultry Science, Clemson University, Clemson, South Carolina
D. L. Cross and B. F. Jenny
Journal of Dairy Science, Vol. 59, No. 5, p. 919-923, May, 1976. 1 fig, 3 tab, 20 ref.

Descriptors: Litters, Feeds, Performance, Rations.
Identifiers: Dairy heifers, Turkey litter silage.

Turkey litter silage was evaluated as a replacement for corn silage in diets for replacement heifers. Twenty-four Holstein heifers from 8 to 12 months of age and averaging 215 kg were assigned randomly by weight to one of 4 groups. All rations contained (dry matter basis) 10 percent of a concentrate supplement plus (1) 90 percent corn silage, (2) 15 percent turkey litter silage and 75 percent corn silage, (3) 30 percent turkey litter silage and 60 percent corn silage, or (4) 45 percent turkey litter silage and 45 percent corn silage, and were formulated to be isonitrogenous. Average daily gains for heifers on 15 percent turkey litter silage were higher than for controls. Urea nitrogen of plasma was higher for animals on 30 percent than 45 percent turkey litter silage. Ruminal ammonia was higher for heifers receiving 30 percent turkey litter silage than for those receiving 15 percent or 45 percent turkey litter silage. Calcium of plasma was highest for the control ration, while plasma phosphorus was highest for the 30 percent and 45 percent turkey litter silage. Ruminal propionate was lower and butyrate higher for the control ration. Turkey litter was found to have potential as a feed ingredient in rations for young dairy animals. However, further research in this area should evaluate the true potential of this feed souree to the dairy industry. (Rowe-East Central)

### 3448 - B2, C1, C2, D3

### SLUDGE ACCUMULATION AND STRATIFICATION IN ANAEROBIC DAIRY WASTE LAGOONS,

Assistant Professor, Agricultural Engineering Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville
R. A. Nordstedt and L. B. Baldwin
Transactions of the ASAE, Vol. 18, No. 2, p. 312-315, March-April, 1975. 2 fig, 6 tab, 7 ref.

Descriptors: Sludge, Dairy industry, Lagoons, Anaerobic conditions.

A lagoon system on a commercial dairy near Bradenton, Florida, was studied in order to: (1) determine the rate of sludge accumulation, and (2) determine the physical characteristics and stratification of the sludge as they related to sludge removal from the lagoon. The anaerobic lagoon received waste from the holding, cow washing, and milking parlor areas. Sludge accumulated in the lagoon at a rate of 14.9 and 16.9 percent of lagoon volume per year. Three zones of biological activity developed. In the first zone, extending from the point of inflow a distance of about 70 meters, the sludge resembled raw manure in appearance. Sludge depth was less than in the other 2 zones, and gas evolution was extensive. The second zone, extending about 70-130 meters from the inlet, contained stratified sludge with lifting occurring from the dense bottom layer. The third zone contained sludge which was darker in color and had a smaller particle size. There was slightly less gas evolution. Vertically, the top layer was supernatant through which masses of sludge were lifted by evolved gas. As the masses of sludge dissipated and settled out of the supernatant, a light sludge layer formed beneath the supernatant. The lower layer was dense, viscous, dark in color, and contained very small particles. The light sludge layer probably contained the most active digestion, and its volume seemed to depend upon the organic loading rate. As this layer was pushed nearer the water surface due to dense sludge accumulation on the bottom, the supernatant volume was reduced and the detention time decreased. When the light sludge level reached the outflow structure, sludge was discharged in the effluent and sludge removal became necessary. (Rowe-East Central)

### 3449 - B2, C1, D1

### SETTLING CHARACTERISTICS OF SWINE MANURE,

Sanitary Engineer, Natural Resources and Environmental Protection Department, Division of Water, State of Kentucky, Frankfort
S. C. Jett, H. E. Hamilton, and I. J. Ross
Transactions of the ASAE, Vol. 18, No. 6, p. 1128-1129, 1135, November-December, 1975. 3 fig, 2 ref.

Descriptors: Settling basins, Design, Physical properties, Separation techniques, Liquid wastes, Sludge.
Identifiers: Swine manure, Solids.

The development of data for the design of settling basins for fresh swine feces and urine was studied. A settling column was used to obtain data for the development of settling curves. Sedimentation characteristics were determined for swine waste with solids concentrations of 0.5, 1, 2 and 3 percent. The data for solids removal as a function of time indicated that a solids concentration of 1 percent would give the highest solids removal efficiencies in a settling basin with no sludge removal. As solids built up in the 2 percent and 3 percent solids concentration studies, they hindered the settling of the particles remaining in suspension. This was caused by the displacement of the water by the settling particles which decreased the removal efficiency of solids at the 4.5 ft. level and below. The 0.5 percent solids concentration study indicated removal efficiencies lower than those achieved in the 1 percent and 2 percent studies after 14 minutes. Overflow rates of 2,000 to 15,000 gal/day-sq. ft. gave estimates of solids removals of about 70 to 45 percent respectively depending on solids concentration in a 6-ft deep settling basin. A mechanical removal device would improve the efficiency of a settling basin and reduce the depth required for storage of solids. The sludge removed should be in the order of 70 to 75 percent of the total solids. (Rowe-East Central)

### 3450 - A8, B1, C2, D3, E2

### EFFECTS OF SHORT-CHAIN FATTY ACIDS EXTRACTED FROM BEEF CATTLE MANURE ON GERMINATION AND SEEDLING DEVELOPMENT,

Agricultural Research Service, High Plains Grasslands Research Station, Cheyenne, Wyoming 82001
G. E. Schuman and T. M. McCalla
Applied and Environmental Microbiology, Vol. 31, No. 5, p. 655-660, May, 1976. 4 fig, 6 tab, 11 ref.

Descriptors: Crop response, Bioassay, Sorghum, Germination.
Identifiers: Short-chain fatty acids, Composted manure, Fresh manure, Corn, Seedling development.

Germination and seedling development of sorghum and wheat were examined in relation to the short-chain fatty acids extracted from beef manure. Composted and fresh beef manure samples were extracted with distilled water, methanol, acetone, 2 N sodium hydroxide, 2 N hydrochloric acid, and ether. The extracts were bioassayed with wheat and sorghum seeds. Bioassays of the composted manure extracts generally showed limited phytotoxic effects on germination and seedling development. All the extracts of fresh manure, except distilled water, retarded germination. While acetic, butyric, propionic, valeric and isovaleric acids were found in ether extracts of fresh manure at average concentrations of 348, 876, 578, 34, and 19 μg/g, respectively, on a dry-basis, only trace amounts of these acids were found in composted manure. Presence of these acids in manure could reduce seed germination and seedling growth if high levels of fresh manure were applied to the soil. Composting the manure on the feedlot would reduce the fatty acids to insignificant levels, making the manure more beneficial to crops. (Rowe-East Central)

### 3451 - A4, A5, A9, A11, A12, B1, F4

### POLLUTED GROUNDWATER: A REVIEW OF THE SIGNIFICANT LITERATURE,

Department of Civil Engineering, University of California, Berkely
D. K. Todd and D. E. O. McNulty
Polluted Groundwater: A Review of the Significant Literature, Water Information Center, Inc., Huntington, New York, 1975, 179 p.

Descriptors: Bibliographies, Farm wastes, Animal wastes, Pesticides, Herbicides, Pollutants, Health, Monitoring.
Identifiers: Groundwater pollution, Literature review, Urban pollution, Industrial pollution, Agricultural pollution, Irrigation return flows, Disposal wells, Injection wells, Recharge wells.

This literature review is concerned with groundwater pollution resulting from man's activities. Literature included was selected on the basis of its significance and relevance from a variety of bibliographies, general references, and abstracts. Excluded from consideration were all unpublished materials, administrative regulations at all government levels, and legal reports. The study was limited to literature of the United States, with the exception of a few Canadian reports and a recent book on the European groundwater pollution situation. Items of historical interest were excluded because they have limited bearing on the current and future pollution situation; only a few references predate 1950. Selections from research reports were restricted to those directly concerning changes in groundwater quality. Chapters II and III contain annotated listings of bibliographies and important general references. Thereafter the literature is reviewed in essay form on a subject basis, including: urban pollution, industrial pollution, agricultural pollution, pollution from wells, salt water and surface water, pollutants and effects, and evaluating pollution. (Merryman-East Central)

This study was undertaken to find a master equation for describing the rheological properties of aerated poultry waste slurries under laboratory and field scale treatments. The study revealed aerated poultry waste slurries to be pseudoplastic and a master equation involving shear stress, shear rate, and volume fraction index was developed. For the temperature ans and shear rate range studied, the effect of temperature on the apparent viscosity of aerated poultry waste slurries was negligible. Thus, for the temperature range experienced in the field (10-25 degrees C), temperature effects may be disregarded when estimating apparent viscosities for design purposes. Because data from rotational and capillary tube viscometers were comparable, the results obtained from rotational viscometer studies can be used for designing pipeline transport systems. Further research is needed to correlate the Fanning friction coefficient with the generalized Reynolds number for pipeline transport of livestock slurries under field conditions. (Merryman-East Central)

## 3446 - A6, B1, C2, D2, D3

### SMELL LIKE MONEY...OR PIG MANURE,

Successful Farming, Vol. 74, No. 12, p. 50, November, 1976.

Descriptors: Odor, Management, Waste treatment, Biological treatment, Chemical treatment.
Identifiers: Swine, Odor control.

Probably the most important step in keeping odors within tolerable limits is to select a site for livestock facilities where odors will be less of a problem. Prevailing wind patterns should be checked. Management practices which may be utilized to combat odor problems include: dilution, ventilation, aeration, covering, burning, absorption, adsorption, masking, and filtration. Chemical treatment of wastes can also reduce odors. Hydrated lime reduces production of hydrogen sulfide and carbon dioxide, but increases ammonia liberation and therefore decreases fertilizer value. Chlorine stops bacterial action, reducing odors, but it also stops breakdown of wastes. Both treatments require relatively large amounts of chemicals. (Merryman-East Central)

## 3447 - A11, B3, C2, E3

### TURKEY LITTER SILAGE IN RATIONS FOR DAIRY HEIFERS,

Department of Poultry Science, Clemson University, Clemson, South Carolina
D. L. Cross and B. F. Jenny
Journal of Dairy Science, Vol. 59, No. 5, p. 919-923, May, 1976. 1 fig, 3 tab, 20 ref.

Descriptors: Litters, Feeds, Performance, Rations.
Identifiers: Dairy heifers, Turkey litter silage.

Turkey litter silage was evaluated as a replacement for corn silage in diets for replacement heifers. Twenty-four Holstein heifers from 8 to 12 months of age and averaging 215 kg were assigned randomly by weight to one of 4 groups. All rations contained (dry matter basis) 10 percent of a concentrate supplement plus (1) 90 percent corn silage, (2) 15 percent turkey litter silage and 75 percent corn silage, (3) 30 percent turkey litter silage and 60 percent corn silage, or (4) 45 percent turkey litter silage and 45 percent corn silage, and were formulated to be isonitrogenous. Average daily gains for heifers on 15 percent turkey litter silage were higher than for controls. Urea nitrogen of plasma was higher for animals on 30 percent than 45 percent turkey litter silage. Ruminal ammonia was higher for heifers receiving 30 percent turkey litter silage than for those receiving 15 percent or 45 percent turkey litter silage. Calcium of plasma was highest for the control ration, while plasma phosphorus was highest for the 30 percent and 45 percent turkey litter silage. Ruminal propionate was lower and butyrate higher for the control ration. Turkey litter was found to have potential as a feed ingredient in rations for young dairy animals. However, further research in this area should evaluate the true potential of this feed source to the dairy industry. (Rowe-East Central)

## 3448 - B2, C1, C2, D3

### SLUDGE ACCUMULATION AND STRATIFICATION IN ANAEROBIC DAIRY WASTE LAGOONS,

Assistant Professor, Agricultural Engineering Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville
R. A. Nordstedt and L. B. Baldwin
Transactions of the ASAE, Vol. 18, No. 2, p. 312-315, March-April, 1975. 2 fig, 6 tab, 7 ref.

Descriptors: Sludge, Dairy industry, Lagoons, Anaerobic conditions.

A lagoon system on a commercial dairy near Bradenton, Florida, was studied in order to: (1) determine the rate of sludge accumulation, and (2) determine the physical characteristics and stratification of the sludge as they related to sludge removal from the lagoon. The anaerobic lagoon received waste from the holding, cow washing, and milking parlor areas. Sludge accumulated in the lagoon at a rate of 14.9 and 16.9 percent of lagoon volume per year. Three zones of biological activity developed. In the first zone, extending from the point of inflow a distance of about 70 meters, the sludge resembled raw manure in appearance. Sludge depth was less than in the other 2 zones, and gas evolution was extensive. The second zone, extending about 70-130 meters from the inlet, contained stratified sludge with lifting occurring from the dense bottom layer. The third zone contained sludge which was darker in color and had a smaller particle size. There was slightly less gas evolution. Vertically, the top layer was supernatant through which masses of sludge were lifted by evolved gas. As the masses of sludge dissipated and settled out of the supernatant, a light sludge layer formed beneath the supernatant. The lower layer was dense, viscous, dark in color, and contained very small particles. The light sludge layer probably contained the most active digestion, and its volume seemed to depend upon the organic loading rate. As this layer was pushed nearer the water surface due to dense sludge accumulation on the bottom, the supernatant volume was reduced and the detention time decreased. When the light sludge level reached the outflow structure, sludge was discharged in the effluent and sludge removal became necessary. (Rowe-East Central)

## 3449 - B2, C1, D1

### SETTLING CHARACTERISTICS OF SWINE MANURE,

Sanitary Engineer, Natural Resources and Environmental Protection Department, Division of Water, State of Kentucky, Frankfort
S. C. Jett, H. E. Hamilton, and I. J. Ross
Transactions of the ASAE, Vol. 18, No. 6, p. 1128-1129, 1135, November-December, 1975. 3 fig, 2 ref.

Descriptors: Settling basins, Design, Physical properties, Separation techniques, Liquid wastes, Sludge.
Identifiers: Swine manure, Solids.

The development of data for the design of settling basins for fresh swine feces and urine was studied. A settling column was used to obtain data for the development of settling curves. Sedimentation characteristics were determined for swine waste with solids concentrations of 0.5, 1, 2 and 3 percent. The data for solids removal as a function of time indicated that a solids concentration of 1 percent would give the highest solids removal efficiencies in a settling basin with no sludge removal. As solids built up in the 2 percent and 3 percent solids concentration studies, they hindered the settling of the particles remaining in suspension. This was caused by the displacement of the water by the settling particles which decreased the removal efficiency of solids at the 4.5 ft. level and below. The 0.5 percent solids concentration study indicated removal efficiencies lower than those achieved in the 1 percent and 2 percent studies after 14 minutes. Overflow rates of 2,000 to 15,000 gal/day-sq. ft. gave estimates of solids removals of about 70 to 45 percent respectively depending on solids concentration in a 6-ft deep settling basin. A mechanical removal device would improve the efficiency of a settling basin and reduce the depth required for storage of solids. The sludge removed should be in the order of 70 to 75 percent of the total solids. (Rowe-East Central)

## 3450 - A8, B1, C2, D3, E2

### EFFECTS OF SHORT-CHAIN FATTY ACIDS EXTRACTED FROM BEEF CATTLE MANURE ON GERMINATION AND SEEDLING DEVELOPMENT,

Agricultural Research Service, High Plains Grasslands Research Station, Cheyenne, Wyoming 82001
G. E. Schuman and T. M. McCalla
Applied and Environmental Microbiology, Vol. 31, No. 5, p. 655-660, May, 1976. 4 fig, 6 tab, 11 ref.

Descriptors: Crop response, Bioassay, Sorghum, Germination.
Identifiers: Short-chain fatty acids, Composted manure, Fresh manure, Corn, Seedling development.

Germination and seedling development of sorghum and wheat were examined in relation to the short-chain fatty acids extracted from beef manure. Composted and fresh beef manure samples were extracted with distilled water, methanol, acetone, 2 N sodium hydroxide, 2 N hydrochloric acid, and ether. The extracts were bioassayed with wheat and sorghum seeds. Bioassays of the composted manure extracts generally showed limited phytotoxic effects on germination and seedling development. All the extracts of fresh manure, except distilled water, retarded germination. While acetic, butyric, propionic, valeric and isovaleric acids were found in ether extracts of fresh manure at average concentrations of 348, 876, 578, 34, and 15 µg/g, respectively, on a dry-basis, only trace amounts of these acids were found in composted manure. Presence of these acids in manure could reduce seed germination and seedling growth if high levels of fresh manure were applied to the soil. Composting the manure on the feedlot would reduce the fatty acids to insignificant levels, making the manure more beneficial to crops. (Rowe-East Central)

## 3451 - A4, A5, A9, A11, A12, B1, F4

### POLLUTED GROUNDWATER: A REVIEW OF THE SIGNIFICANT LITERATURE,

Department of Civil Engineering, University of California, Berkely
D. K. Todd and D. E. O. McNulty
Polluted Groundwater: A Review of the Significant Literature, Water Information Center, Inc., Huntington, New York, 1975, 179 p.

Descriptors: Bibliographies, Farm wastes, Animal wastes, Pesticides, Herbicides, Pollutants, Health, Monitoring.
Identifiers: Groundwater pollution, Literature review, Urban pollution, Industrial pollution, Agricultural pollution, Irrigation return flows, Disposal wells, Injection wells, Recharge wells.

This literature review is concerned with groundwater pollution resulting from man's activities. Literature included was selected on the basis of its significance and relevance from a variety of bibliographies, general references, and abstracts. Excluded from consideration were all unpublished materials, administrative regulations at all government levels, and legal reports. The study was limited to literature of the United States, with the exception of a few Canadian reports and a recent book on the European groundwater pollution situation. Items of historical interest were excluded because they have limited bearing on the current and future pollution situation; only a few references predate 1950. Selections from research reports were restricted to those directly concerning changes in groundwater quality. Chapters II and III contain annotated listings of bibliographies and important general references. Thereafter the literature is reviewed in essay form on a subject basis, including: urban pollution, industrial pollution, agricultural pollution, pollution from wells, salt water and surface water, pollutants and effects, and evaluating pollution. (Merryman-East Central)

### 3452 - A11, B2, C2, D3
### LIQUID MANURE, POSSIBILITIES OF DECOMPOSITION BY MEANS OF AEROBIC WASTE WATER CLEANSING METHODS,

H. Liebmann and K. Scherb
Wasser-und Abwasser-Forschung, Number 1, p. 8-11, January, 1971. 5 tab, 6 ref.

Descriptors: Liquid wastes, Aerobic treatment, Activated sludge, Ammonia, Drying, Nitrification, Waste water treatment.
Identifiers: Detention time, Toxicity.

Aerobic biological treatment of liquid manure can be accomplished by special activated sludge plants. For this treatment, manure has to be diluted in a 1 to 1 ratio with water. The plant should be operated with sludge loadings below 50 BOD per kg MLSS per day and detention times of more than 20 to 30 days. Liquid manure has a high percentage of ammonium hydroxide which has to be oxidized, since it is toxic to fish. Tests show that ammonium can be nearly completely nitrified, if the oxygen content and the reaction time in the activated sludge plants is sufficient. However, biological treatment demands areas in which the excess sludge can be deposited. Excess sludge has a very good drying property. After 1 to 2 days, it is reduced to half the volume without developing odors. After a short drying time, the water content was 91 to 93 percent, and after 3 months, only 87 to 88 percent. (Text in German) (Solid Waste Information Retrieval System)

### 3453 - B1, C2, D2, E3
### FROM AGRICULTURAL WASTES TO FEED OR FUEL,

Chemical Engineering News, Vol. 50, No. 22, p. 14-15, May 29, 1972. 1 fig.

Descriptors: Recycling, Feeds, Fuels, Farm wastes, Hydrogenation.
Identifiers: Bureau of Mines, Pyrolysis, Refeeding.

Studies were conducted by the Bureau of Mines to determine the use of agricultural wastes for feed or fuel. Two processes were explored for converting such waste to fuel. One was a pyrolysis method, in which the feed was heated in a closed system at atmospheric pressure without the addition of air or other gas. In the second method, hydrogenation, the feed was heated under pressure in the presence of carbon monoxide, steam, and a catalyst, also in a closed system. Hydrogenation offers the most commercial promise. The reason is that it yields a single produce (oil), which would be simpler and more economical to produce, store, and market than would the 3 products formed by pyrolysis. An alternative use for bovine manure is as a raw material for making cattle feed. Bovine manure may be anaerobically fermented to convert it to a more usable form. The method not only produces an animal feed but also a fuel gas (methane), which can be burned to supply the heat and indirectly the electrical power needed for the process. The single most important question yet to be answered is the actual nutritional value of the feed ingredient when fed to ruminants. (Rowe-East Central)

### 3454 - B1, C2, D3, E3
### THE ANAEROBIC DIGESTION OF LIVESTOCK WASTES TO PRODUCE METHANE: 1946-June 1975; A BIBLIOGRAPHY WITH ABSTRACTS,

Center for Studies of Physical Environment, Institute of Technology, University of Minnesota, St. Paul 55108
G. Shadduck and J. A. Moore
The Anaerobic Digestion of Livestock Wastes to Produce Methane, 1946-June 1975; A Bibliography with Abstracts, University of Minnesota, December, 1975, 103 p.

Descriptors: Bibliographies, Anaerobic digestion, Methane, Farm wastes, Fertilizers, Effluents.

This bibliography of 416 entries and abstracts covers materials published from 1946 to June, 1975, concerning anaerobic digestion of livestock wastes to produce methane. Sources from which the entries were first identified include: Bibliography of Agriculture, Bibliography of Agriculture computer search, Chemical Abstracts, Water Pollution Abstracts, Commonwealth Bureau of Soils annotated bibliography no. 674; Manure Gas, London Science Museum Science Library bibliographical series no. 794; Some Post-War References to "Bio-Gas", Dokumentation Lantechnik, Braunschweig-Volkenrode, bibliography; Biogas, Commission Internationale des Industries Agricules bibliography 2650; Bibliographie Sur La Production Du Gas De Methane Par Fermentation Du Fumier Et Des Residus Agricoles, En Vue De Son Utilisation A La Ferme. In addition to these, there were other articles which the authors identified and abstracted themselves. Recent popular articles were generally excluded. Four appendices give the following information: (1) Bibliographic entries for publications concerning anaerobic digestion of farm-generated cellulosic materials. (2) Bibliographic entries for publications concerning fertilizing qualities of digester effluent, (3) Search methodology and limitations, and (4) A tabular summary of recent literature pertaining to continuous fed digesters. (Merryman-East Central)

### 3455 - A2, A11, B1, D3, E2, F1
### ANIMAL WASTE - A PROBLEM OR AN OPPORTUNITY,

United States Environmental Protection Agency, Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma 74820
W. C. Galegar and L. R. Shuyler
Water — 1972, AIChE Symposium Series, New York, American Institute of Chemical Engineers, 1973, p. 167-171. 12 ref.

Descriptors: Farm wastes, Agricultural runoff, Feedlots, Economics, Recycling, By-product recovery, Pathogenic bacteria.
Identifiers: Environmental Protection Agency, Research, Land disposal, Fish kills.

During the last 15 years, modernizing animal productions has resulted in the concentration of large feeding operations. This concentration of animals has eliminated the natural capacity of the environment to assimilate waste at the point of excretion. There are three major problem areas in animal waste management: (1) beef cattle feedlot waste (2) dairy waste, and (3) swine waste. In the mid 1960's, over 80 percent of the fish kills and a number of disease transmissions were caused by rainfall runoff from concentrated feeding operations. Some purification methods for rainfall runoff are treatment, reuse, and land disposal. EPA emphasized the land disposal method. Because of the economy of commercial fertilizers, land disposal methods have been neglected. Properly applied waste can provide an economic return and waste must be disposed of in some manner. In many locations sufficient land for waste disposal is becoming scarce. So, EPA has been researching methods of gas production from animal waste and refeeding of animal waste back to animals. The type of feed rations and collection methods used may be dictated by type of by-product recovered. (Cannon-East Central)

### 3456 - A1, C2, C3
### BIOGENIC SEDIMENTATION AND ALTERATION OF ARGILLACEOUS SEDIMENTS IN SHALLOW MARINE ENVIRONMENTS,

H. N. Fisk Laboratory of Sedimentology, University of Cincinnati, Cincinnati, Ohio 45221
W. A. Pryor
Geological Society of America Bulletin, Vol. 86, No. 9, p. 1244-1254, September, 1975. 12 fig, 3 tab, 44 ref.

Descriptors: Marine animals, Sedimentation, Digestion.
Identifiers: Callinassa major Say, Onaphis microcephala Hartman, Fecal pellets, Argillaceous sediments.

The feeding activities and excretory products of the marine decapod Callinassa major Say and the marine anaeiid Onuphis microcephala Hartman were studied in shallow marine environments of the southern Atlantic and eastern Gulf of Mexico coasts of the U.S. These filter-eating organisms produce significant quantities of argillaceous fecal pellets which are transported and deposited as granular clay with hydraulically equivalent quartz and grains. At average population densities observed in shallow marine environments, these organisms are able to remove and pelletize approximately 12 metric tons of suspended materials per square kilometer per year. The digestive processes of these organisms wholly or partly destroy chlorite, partly destroy mixed-layer clay minerals, and disorder kaolinite and illite. The fecal pellets rich in organic matter, result in the development of biogenic muds of relatively concentrated high organic content. These organic-rich fecal pellets may serve as progenitors of glauconite pellets, furnishing sites for the microreducing environments necessary for the glauconitization processes. Whereas flocculation is the important process in the deposition of argillaceous sediments in deltaic environments, biogenic pelletization may be the most important process in depositing argillaceous sediments in shallow marine interdeltaic environments. (Rowe-East Central)

### 3457 - A4, A7, A8, A11, B2, C2, E2
### DAIRY MANURE MANAGEMENT FOR POLLUTION CONTROL,

Delta Engineering, Inc., Sumner, Washington
W. Dalrymple
Dairy Science Handbook 5, p. 142-143, 1972.

Descriptors: Daily industry, Air pollution, Water pollution, Anaerobic lagoons, Waste storage, Irrigation, Crop response, Nitrogen, Phosphorus, Biochemical oxygen demand.
Identifiers: Field application.

Animal wastes are a significant problem in air and water pollution. Many attempts have been made with different systems to meet requirements that are presently established by regulatory agencies. Often these develop as a result of the one-step-at-a-time approach imposed without warning by regulatory agencies. Because of the expense and general poor treatment of the resulting management practice an extensive research project was undertaken in More, Washington, to demonstrate the practicality of seasonal application to fields, together with storage. Criteria which must be taken into consideration are climate, land values, soil conditions, etc. A roof was built over the area where the cows were kept to reduce rainfall addition to wastes. All the wastes (about 20 gal/animal—10 excrement and 10 for flushing) was pumped into anaerobic lagoons which provided 8 months storage. The lagoons quickly developed surface crust which eliminated odors and flies. Little treatment occurred because the waste was stored during the winter. Effluent from the lagoons was approximately 3000 ppm BOD, total nitrogen about 1,000 ppm, and total phosphorus about 110 ppm. This was applied to the fields at 40,000 gal/acre 4 times per growing season. A 150,000 gal/acre rate proved to be in excess and killed all the clover in the green chop. Tests conducted on phosphorus, nitrogen, and bacterial movement through the soil revealed that bacteria (coliform) moved less than a few inches and a buildup of movement of nitrogen and phosphorus was not detected past the root zone of the grass. When the spraying occurred during the wet season, nitrogen moved readily through the soil. Green chop was cut and fed to the cattle with no ill effects or rejection. Compared to any other scheme, manure management by this method seems to be the best solution available. (Ott-East Central)

### 3458 - A8, B2, E2
### THE DISPOSAL OF COW SLURRY ON ARABLE LAND. PART I. APPLICATION AND INITIAL EFFECTS,

Trawscoed E.H.F.
H. T. H. Cromack and D. O'Connell
Experimental Husbandry, Vol. 28, p. 69-80, 1975.

Descriptors: Potatoes, Slurries, Dairy industry, Waste disposal, Crop response, Nutrients.
Identifiers: Land disposal, Application rates.

An experiment was started at Bridget's Experimental Husbandry Farm in 1969 to investigate the effect of applying large quantities of cow slurry to arable land. The experiment was carried out on four sites in four successive years 1969-72. On all sites the soil was Andover series, a well /structured calcareous silty loam with upper chalk at 30-46 cm below the surface with an organic carbon content of 1.9 percent. Drainage was natural and very good. The slurry contained feces and urine from dairy cattle. It also contained a small quantity of sawdust which had spilled from the housed dairy cubicle beds. Slurry disposal is described in terms of cow-equivalents. A cow-equivalent is the quantity of slurry produced by one cow housed for 364 days. It was found that the application of more than 8 cow-equivalents caused serious runoff problems and made it difficult to plant potatoes in the spring. Cultivating the soil and applying slurry in smaller but more frequent applications reduced but did not eliminate surface runoff. Large quantities of nutrients were applied with the slurry; these raised the soil nutrient status in proportion to the quantity of slurry applied. Slurry application increased the yield of potatoes compared with an inorganically fertilized treatment. Potato yields were little affected by the quantity of slurry applied. (Cameron-East Central)

## 3459 - A8, B3, C2, E2

## EFFECT OF FARM YARD MANURE ON THE AVAILABILITY OF CA FROM $CA^{45}$ $CO_3$ IN A SODIC SOIL (ESP 77.7),

Department of Soils, Haryana Agricultural University, Hissar, India
S. R. Poonia and D. R. Bhumbla
Plant and Soil, Vol. 38, No. 3, p. 679-682, 1973. 4 tab, 8 ref.

Descriptors: Calcium, Calcium carbonate, Crop response.
Identifiers: Land application, Sodic soil, Fary yard manure, Dhaincha,

An evaluation was made of the effect of farm yard manure (FYM) on the availability of Ca from Calcium carbonate in a non-saline sodic soil, using $Ca^{45}$ $CO_3$. Three and a half kg of a non-saline sodic soil were separately weighed for 12 polyethylene lined earthern pots. Four levels of FYM, 0, 3, 6 and 9 percent on dry-weight basis, were thoroughly mixed into the soil, keeping 3 replications. Five me of tagged $CaCO_3$ per 100 g soil was thoroughly mixed in the soil at all levels of FYM and treated soil was watered, equilibrated for 7 days, remixed, and planted with 20 dhaincha seeds. Nitrogen, phosphorus, and potassium were applied at a rate of 50, 20, and 20 mg /kg soil respectively. Ten plants of dhaincha were allowed to grow in each pot for 50 days, harvested, washed, dried, weighed, ground and analyzed for Ca, Mg, Na, K, P, N, and $Ca^{45}$. Results showed: (1) even with the use of FYM, the contribution of Ca from $CA^{45}$ $CO_3$ is less than 6 percent of the total Ca in plant, (2) dry matter yield of plant tops is negatively related with Na content and positively with Ca:Na ratio, (3) apart from increased availability of Ca from Ca $Co_3$ with the application of FYM, other factors—(a) improvement in soil physical conditions, (b) supply of nutrients, and (c) probable decrease in the activity of Na in the growth medium, also seem to be the probable reasons for increased dry matter yield, and (4) the increase in the total uptake of Ca from the soil as well as applied $Ca^{45}$ $CO_3$ in response to FYM seems to be because of an increased root growth and increased availability of Ca. (Rowe-East Central)

## 3460 - A9, A12, B3, D2

## THE EFFECT OF FUMIGATION WITH METHYL BROMIDE OR FORMALDEHYDE ON THE INFECTIVITY OF POULTRY HOUSE LITTER NATURALLY CONTAMINATED WITH SALMONELLA VIRCHOW,

Houghton Poultry Research Station, Houghton, Huntingdon, England
J. F. Tucker, E. G. Harry and H. E. Wainman
British Veterinary Journal, Vol. 131, No. 4, p. 474-485, 1975. 1 fig, 21 ref.

Descriptors: Litters, Salmonella, Chemical treatment, Poultry, Fumigants.
Identifiers: Infectivity, Methyl bromide, Formaldehyde.

The purpose of this investigation was to determine the effectiveness of methyl bromide (MeBr) fumigation in rendering litter naturally contaminated with Salmonella virchow, noninfectious to chicks in experimental animal accommodation, a comparison being made with the use of formaldehyde (HCHO) for this purpose. S. virchow was used as a test organism because it has been implicated in cases of food poisoning originating from infected poultry carcasses. The effectiveness of the fumigation process was also determined by measuring the reduction in Salmonella contamination in the treated litter. Application of methyl bromide at 2 dosage rates and at various temperatures resulted in widely varying treatments, in terms of the measured concentration-time products, in the approximately 20-hour exposure period allowed. However, in no case was the litter rendered noninfectious to chicks. A single trial with formaldehyde was also ineffective. In some of the tests where relatively small amounts of MeBr were used, fumigation seemed to enhance litter infectivity. In 3 of the 4 tests in which MeBr fumigation was carried out with concentration-time products of 430 mg h / litre and less at floor level, and in the test using HCHO fumigation, the incidence of salmonellosis was higher in the chicks on the fumigated litter, than in those on the unfumigated litter. The apparent lack of effect of formaldehyde fumigation on the Salmonella content of the litter was considered to have resulted from the method of sampling the litter, in which both subsurface and surface layers were included. (Rowe-East Central)

## 3461 - A8, E2

## EFFECT OF GYPSUM AND MANURE ON THE GROWTH OF WHEAT IRRIGATED WITH BICARBONATE RICH WATER,

Rajasthan Salinity Laboratory, Jodhpur, Rajasthan, India
S. S. Puntamkar, P. C. Mehta, and S. P. Seth
Journal of the Indian Society of Soil Science, Vol. 20, No. 3, p. 281-285, 1972. 2 tab, 17 ref.

Descriptors: Crop response, Gypsum, Irrigation, Wheat, Sodium, Calcium, Magnesium, Potassium.
Identifiers: Manure, Land application.

A field experiment was conducted to study the effect of gypsum and manure on soil properties and crop yield. Gypsum was applied at 5, 10, and 20 tons /ha and manure at 15 and 30 tons /ha alone or in combination with one another. Wheat (Sonora 64) was grown as a test crop. The crop was irrigated with bicarbonate rich water. Gypsum and manure was found to increase wheat yield when they were applied separately or in combination. The highest yield was recorded when 20 tons of gypsum was applied alone. The application of manure with gypsum was found to enhance the replacement of exchangeable sodium. The decrease in exchangeable sodium ranged from 1.6 to 10.9 percent by the addition of gypsum and manure; whereas, exchangeable calcium was found to increase up to 17.7 percent. Exchangeable magnesium was found to decrease from 0.3 to 11.4 percent; whereas, potassium increased 0.8-3.6 percent. (Merryman-East Central)

## 3462 - A8, B1, E2

## EFFECT OF ORGANIC AMENDMENTS ON CERTAIN SOIL ENZYMES,

Microbiological Laboratory, Department of Biology, Tamil Nadu, Agricultural University, Coimbatore - 641003, Tamil Nadu, India
D. Purushothaman and R. Kesavan
Indian Journal of Microbiology, Vol. 14, No. 3, p. 137-138, 1974. 1 tab, 9 ref.

Descriptors: Fertilizers, Farm wastes.
Identifiers: Soil amendments, Soil enzymes, Land disposal.

The effect of certain soil amendments on soil enzymes is examined. Ten kg each of read loam and black cotton soils of Coimbatore tract were taken in circular cement pots. Well powdered groundnut cake (GNC) and farm yard manure (FYM) were separately mixed with the soil in calculated quantities to obtain 40 kg level of nitrogen /ha. The treatments were sufficiently replicated with appropriate controls. The soils were maintained at 50 percent moisture holding capacity throughout the study and samples were collected on the 1st, 5th, 10th, 20th, 30th, and 45th days. One g quantities of soil samples were incubated with the appropriate substrates for 24 hr. at 37 degrees C. The reaction mixture was clarified by centrifugation at 2100 x g for 15 min. and the end products formed were determined in a Spectronic-20 colorimeter. Results showed that the black and red loamy soils when amended with FYM and GNC exhibited increased enzyme activities. ∝-Amylase and invertase were found to be relatively more active in the 2 soils than glucosidase and cellulase. GNC amended soils increased amylase activity; FYM enhanced invertase activity. FYM amendment enhanced B-glucosidase activity only in black soil. GNC amendment increased the same in red soil. ∝-Amylase activity of soil was positively correlated with organic matter content. The FYM and GNC soil amendments increased ∝-amylase activity. Cultivated neutral soils were characterised by greater activity of invertase; whereas, sandy soils exhibited poor activity. The black soil exhibited more invertase activity than did red loam. Addition of organic amendments slightly increased B-glucosidase activity. Cellulase was found to have a feeble activity in soil, possibly because cellulose is not an obligatory carbon source to soil microorganisms since the microorganisms have a broad nutritional base. (Ott-East Central)

## 3463 - A11, B2, B4, C3, F6

## THE EFFECT OF STORAGE IN SLURRY ON THE VIRULENCE OF SALMONELLA DUBLIN,

Agricultural Research Council, Institute for Research on Animal Diseases, Compton, Newbury, Berkshire
P. W. Jones
Journal of Hygiene, Vol. 74, p. 65-70, 1975. 3 tab, 6 ref.

Descriptors: Waste storage, Slurries, Pathogenic bacteria.
Identifiers: Virulence, Salmonella dublin, Mice, Bacto-tryptose (BT), Animal health.

Research was done to determine whether storage of Salmonella dublin in slurry and in broth reduces the virulence of the organism. An aerogenic smooth strain of S. dublin isolated by M. H. Hinton from a case of abortion in a dairy cow was used. White BSVS male mice were used at an average weight of 21 g. All mice, housed one animal per cage, received 0·25 ml. of inoculum delivered into the stomach from a syringe needle with a 'pear drop' end. Bacto-tryptose (BT) broth was prepared according to the formula: bactotryptose (Difco), 20 g., sodium chloride 5 g., sodium glycerophosphate 2 g., glucose 1 g., distilled water 1000 ml., and had a pH of 7.4. Slurry, collected from a dairy farm lagoon, was centrifuged at 1000 g for 2 min. to remove fiber. Slurry and BT were stored in 200 ml. volumes in a water bath at 10± 0.1 degrees C. No apparent reduction in virulence was noted in S. dublin stored either in slurry for up to 36 days or BT for up to 70 days. Mortality was slightly higher in groups of mice which had received stored rather than freshly prepared S. dublin. It appears that S. dublin survives in slurry for up to a month without loss of virulence. The disease risk associated with infected slurry is presumably related to the number of pathogenic organisms present rather than to their virulence. Although S. dublin will remain capable of causing disease, the risk to other animals of contaminated slurry will depend on other factors including the number of animals in a herd-excreting the organism, the dilution of infected excreta with non-infected excreta, the period for which the slurry is stored prior to spreading on pasture and the time elapsing before infected pasture is grazed. (Cameron-East Central)

### 3464 - A6, B2, C1, C2, D3
### ENHANCED TREATMENT OF LIVESTOCK WASTEWATER. III. ENHANCED AEROBIC TREATMENT OF SWINE WASTE BY ANAEROBIC PRE-CONDITIONING,

Assistant Professor, Agricultural Pollution Control Laboratory, Department of Agricultural Engineering, Michigan State University, East Lansing, 48823.
J. B. Gerrish, J. P. Harper, and P. O. Ngoddy
Journal of Agricultural Engineering Research, Vol. 20, p. 13-23, 1975. 11 fig, 5 tab, 12 ref.

Descriptors: Biological treatment, Aerobic conditions, Anaerobic conditions, Slurries, Chemical properties, Physical properties, Odor, Temperature.
Identifiers: Swine wastes, Holding times, Foaming.

A slurry of screened hog waste, diluted fivefold, was pre-treated anaerobically and then it was aerobically treated. Four anaerobic holding times were tested to determine which one would minimize subsequent aerobic treatment time. The holding times were 0, 3, 7, and 10 days. Air was admitted to those systems after the respective holding times and aeration was continued for a period of not less than 10 days in any case. It was found that: (1) reductions in the order of 60-80 percent in chemical oxygen demand, total solids, volatile solids, and suspended solids can be obtained for strong hog wastes, (2) these reductions can be achieved in reasonable times, i.e. of the order of 10 days, (3) anaerobic pre-conditioning can reduce the aeration requirements for a prescribed degree of treatment; 40 percent reduction in aeration energy was realized after 10 days' pre-conditioning, and (4) the test for total solids is unreliable for liquors containing high concentrations of volatiles such as the volatile fatty acids. The success of the anaerobic pre-conditioning depends on maintaining the anaerobic stage at an elevated temperature. Whatever supplemental energy is expended in heating the anaerobic stage can probably be more than compensated by the saving in aeration energy. The odors emanating from the batch processes were unacceptable. Some foaming was observed shortly after the onset of aeration. (Rowe-East Central)

### 3465 - A4, A7, C2
### ABSORPTION OF AMMONIA BY AQUEOUS SOLUTIONS IN A DAIRY AREA,

R. E. Luebs
Summaries of Papers, Statewide Conference on Crises and Conflicts in Agro-Ecosystems, University of California (Division of Agricultural Sciences). Berkeley, December 21-22, 1970, p. 42-43.

Descriptors: Ammonia, Absorption, Dairy industry, California, Air pollution, Water pollution, Soil pollution.
Identifiers: Acid traps, Water traps.

Three hundred sixty dairies are located in a 55-square mile area west of Riverside and southeast of Pomona, California. Preliminary sampling of ammonia absorption by dilute acid and water was made ½ mile from this area's densest accumulation of dairies. Over a 10-day period in November before the winter rainfall season, ammonia absorption by dilute acid in the dairy area exceeded that at a control site by a factor of 50. The control site was located at an airport, 6 miles from the dairy area. Urban residences and business areas lay between the dairy area and the control site. Absorption in an agricultural area devoted to crops and with widely scattered chicken ranches was 6 percent of that in the dairy area. Drying of wet dairy corrals markedly increased volatilization of ammonia. Ammonia concentration outside the most densely populated dairy area decreased with distance. Absorption of ammonia by water in traps over periods of 3-4 days was from 55 to 75 percent that absorbed in dilute acid. Ammonia content of rainfall collected over a 3-week period was 5 times greater than at the control site. Open water and soils around dairies or feedlots are likely to be enriched in nitrogen by absorption of ammonia and through its solution in rainfall. (Merryman-East Central)

### 3466 - A11, B2, C3, E2
### EXAMINATION OF SLURRY FROM CATTLE FOR PATHOGENIC BACTERIA,

Agricultural Research Council, Institute for Research on Animal Diseases, Compton, Newbury, Berkshire
P. W. Jones and P. R. J. Matthews
Journal of Hygiene, Vol. 74, p. 57-64, 1975. 2 fig, 1 tab, 18 ref.

Descriptors: Slurries, Cattle, Pathogenic bacteria, Salmonella.
Identifiers: Brucellas, Leptospires.

A number of slurry systems were examined to assess the degree to which they were contaminated with pathogenic microorganisms. Since many pathogenic microorganisms may be excreted in the feces of infected animals, slurry could be a potential hazard to farm animals when applied to pasture. One hundred and eighty-seven samples of slurry from cattle were examined for the presence of salmonellas, pathogenic leptospires and brucellas. Twenty strains of Salmonella identified as *S. dublin*, 4 as *S. Typhimurium* and 4 as other serotypes. These were *S. indiana*, *S. bredeney*, *S. cerro* and *S. 4, 12:d*:—. All strains produced gas in 1 percent glucose peptone water and none were agglutinable in 1/500 neutral acriflavine. Sixty-four suspected leptospire colonies from 56 slurry samples were examined and confirmed as treponemas by dark-field microscopy. Sixty-four hamsters inoculated with these organisms survived up to 21 days when they were killed. No brucellas were isolated. The total colony count per sample of slurry ranged widely, with a maximum at $10^9$ organisms/g. The coliform count ranged from less than $10^3$/g. to more than $10^6$/g. with most samples containing between $10^5$ and $10^8$ coliforms/g. The total solids concentration of the samples ranged from less than 1 percent (one sample) to 19 percent with a mean of 11.3 percent. There were two samples outside the range at 26 percent and 34 percent. (Cameron-East Central)

### 3467 - A4, A7, B1, B2, B3, B4, D1, D2, D3, E2, F1
### EXPERIMENTS OF SLURRY HANDLING, TREATMENT, AND LAND APPLICATION AT THE N.I.A.E., 1968-1974,

National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedford, MK45 4HS
R. Q. Hepherd
Report No. 15, National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedford, MK45 4hS, February, 1975, 24 p. 3 fig, 10 tab, 27 ref.

Descriptors: Slurries, Separating techniques, Waste storage, Solid wastes, Liquid wastes, Biological treatment, De-watering, Economics, Flocculation, Anaerobic conditions, Air pollution, Water pollution.
Identifiers: Land spreading, Great Britain.

This report reviews the applied research carried out at the National Institute of Agricultural Engineering between 1968 and 1974 to overcome farm problems, and in particular, to investigate slurry separation, biological treatment and sludge de-watering. The main conclusions from the work to-date are as follows: Separating (1) The separation of slurries before storage and land spreading produces smell-free solids that are easy to stack and spread on land and liquids that are also easy to store and to spread, (2) The liquid and solid products of separation appear easier to apply and better for the crops than slurries, (3) Studies of the economic viability of separation systems require farm measurements, and (4) The capital cost incurred in slurry separation may well be outweighed by the benefits. Treatment—(1) Treatment of animal manures to produce an effluent meeting Royal Commission standards is very difficult, (2) A high proportion of the output of effluent liquid plants must be applied to land, (3) De-watering is important if the wet sludges produced by treating slurries are to be converted to easily stored and handled solids, (4) If virtually all the slurry is converted into solids which can be easily transported, stored and spread elsewhere, the problems of farms which are short of land for spreading are greatly reduced, (5) Improvement separation and treatment stages of a complete slurry treatment process to reduce de-watering costs, may be possible by means of flocculation or other sludge de-watering aids, (6) The processes used to date have been satisfactory with slurries which have been stored under anaerobic conditions, and (7) The fibrous solids, de-watered sludge, and filtrate, are unlikely to cause air or water pollution problems. (Rowe-East Central)

### 3468 - A7, B1, B4, C2
### FACTORS AFFECTING THE RELEASE OF GASES FROM BOVINE WASTE,

Oregon State University, Corvallis
R. O. Kellems, D. C. Church and J. R. Miner
Proceedings, Western Section, American Society of Animal Science, Vol. 27, 1976, 5 p. 7 tab, 17 ref.

Descriptors: Gases, Diets, Waste storage, Crude protein, Urea, Specific gravity.
Identifiers: Volatilization, pH, Dry matter, Storage period.

The effect of different sources of grains (corn, barley, and Milo) and levels of supplementation (25, 50, 75 percent) on the initial volatilization of volatile gases from animal wastes and several variables that are associated with animal wastes (crude protein content, urea content of urine, specific gravity of urine, pH of feces, storage period, and dry matter content) were studied through the implementation of 4 separate experiments. Results of the experiments indicated that cereal grain source and level in a ration affects the initial volatilization of hydrogen sulfide and volatile nitrogenous gases. This change in relative amounts of hydrogen sulfide and ammonia was thought to be due to changes in the pH of the wastes; this is especially important with respect to ammonia release due to a direct relationship between pH and ammonia volatilization. Increasing the moisture content of the waste reduced the evolution rate of ammonia and amines during the initial storage period. Of the variables measured, it was found that the urea, specific gravity and moisture content of the waste were the most highly correlated with volatilization of nitrogenous gases. Further research must be done to determine how practical this approach would be in predicting and controlling the production of volatile gases from bovine waste. (Rowe-East Central)

### 3469 - A11, B3, C2, E3
### GROWTH OF BROILERS FED ON DIETS CONTAINING DRIED POULTRY MANURE,

Agricultural Research Council's Poultry Research Centre, King's Buildings, West Mains Road, Edinburgh EH9 3 S, Scotland
D.J.W. Lee and R. Blair
British Poultry Science, Vol. 14, No. 4, p. 379-388, 1973.

Descriptors: Diets, Poultry, Performance.
Identifiers: Broilers, Refeeding, Dried poultry manure, Food conversion efficiency.

One experiment, using purified diets, tested whether autoclaving had any effect on the utilization of dried poultry manure (DPM) and whether the essential amino acid content of DPM explained the greater growth rate compared with the basal diet. A second experiment studied the effect on performance of feeding diets, which had been formulated to include DPM, to broilers for periods up to 8 weeks under commercial conditions. In the first experiment, 60 7-day-old male broiler chicks housed in individual metabolism cages were offered 1 of 6 purified diets for 14 days. These basal diets, formulated to have the same ME contents, had different nitrogenous supplements. Diet A contained PRC essential amino acid mixture equivalent to 15 g N/kg; B, basal+12 percent glutamic acid; C, basal plus essential amino acid mixture equivalent to essential amino acid content of 20-09 percent DPM; D, basal + essential amino acid + 12 percent glutamic acid; E, basal + 20-09 autoclaved DPM; F, basal + 20-09 percent unautoclaved DPM. The rank order of final body weights at 21 days of chicks fed on these diets were: $D(292g) > B(258\ g) > F(254\ g) > E(253\ g) > A(180\ g)$, $>(P\ 0.05)$. Chicks fed diet C had better food conversion efficiency than those fed diet A, and D was better than B. In the second experiment, 24 groups of broiler chicks were given commercial-type diets containing 0 percent of 5 percent DPM from 1 day of age for 4 weeks. From 4-8 weeks of age, one of the three diets with 0 percent, 5 percent or 10 percent DPM was fed according to a 2 (sexes) x2x3 factorial design. Between 0 and 4 weeks, feeding DPM had no significant effect on body weight or food consumption, but birds receiving 5 percent DPM had an improved food conversion efficiency. Between 4 and 8 weeks, birds fed 5 and 10 percent DPM were heavier than the controls at 6 weeks, but this increase was not significant at 8 weeks. Food consumption was not affected, but the food conversion efficiency improved with the increasing inclusion of DPM. At 8 weeks, birds fed 5 percent DPM were heavier than birds fed none. (Penrod-East Central)

### 3470 - A8, E2

### INFLUENCE OF FARMYARD MANURE ON SOIL STRUCTURE AND SOME RELATED SOIL PROPERTIES,

Department of Soils, Haryana Agricultural University, Hissar, India
M. C. Sarkar, M. Singh, and J. Nath
Journal of the Indian Society of Soil Science, Vol. 21, No. 2, p. 227-229, June, 1973. 1 tab, 10 ref.

Descriptors: Soil amendments, Organic matter, Sampling, Hydraulic conductivity, Saturation.
Identifiers: Farmyard manure.

An investigation was undertaken to study the role of farmyard manure in improving soil physical properties. Soil samples were collected in 1970-1971 from surface and subsurface soil layers of a permanent manurial experimental field at Haryana Agricultural University Research Farm. The study data indicated a significant increase in percentage aggregate for samples collected after 57 and 104 days of manure application which declined thereafter, and over a period of 340 days no significant change was noticed. Likewise, there was some initial lowering of bulk density after manure application, but this improvement was also temporary. Increased doses of farmyard manure caused significant increase in organic matter. However, the increased organic matter started declining from 97 percent to 77 percent and further to 57 percent in samples collected after 57, 104, and 185 days, respectively. Organic matter content did not change thereafter, showing the constancy with the climate and ecological conditions. From these data, it was determined that adequate addition of farmyard manure must be made every 6 months in order to maintain the level of increased organic matter. Benefits to be found in this increased organic matter are increased hydraulic conductivity and increased saturation percentage. Also, the physical condition of the surface soils is improved. (Rowe-East Central)

### 3471 - A11, B3, C1, D1, E3, F1

### THREE-YEAR DPW PRODUCER SURVEY SHOWS BULK PRICE $5-9 PER TON,

Feedstuffs, Vol. 48, No. 50, p. 28, December 6, 1976.

Descriptors: Economics, Recycling, Fertilizers, Feeds, Performance.
Identifiers: Dried poultry wastes, Refeeding, Application rates.

A survey of dried poultry waste (DPW) producers showed bulk sales from farms ranged in price from $5-9/ton from 1973-1976. Stage one sales of DPW by 8 producers totaled 14,200 tons for a three-year period, and the average price was $5.95/ton at the farm where it was produced. Another 14,000 tons of DPW were used on local fields owned or leased by producers. Stage two sales totaled 24,000 tons for the first-year period. Average price for all stage two DPW was $62.62/ton. The DPW producers surveyed made these observations: (1) Cost of stage one is about $20/ton for the final product (2) Cost of stage 2 is usually over $60/ton for the final product. (3) There is a need to develop markets or uses for DPW that don't involve fertilizer or organic supplements. (4) Stage two product at 9 percent moisture was fed back to growing pullets at levels up to 10 percent of total ration from 8-18 weeks with no adverse effect on laying house performance. (5) Stage one drying reduces moisture to 25-60 percent while stage two reduces moisture 7-10 percent moisture. At 7 percent moisture over half of the total nitrogen is usually lost. (6) Manure out to the house must be below 60 percent moisture when entering dehydrator to be dried readily with minimum use of fuel. (7) The best application rates of stage one manure are 2 tons/acre for hay and small grains/year, while corn ground may take up to 8 tons/acre/year. (Merryman-East Central)

### 3472 - A1, A2, A4, B1, B2, B4, D3, E2

### LIVESTOCK WASTE DISPOSAL - A MOUNTING PROBLEM,

Research Officer, New Zealand Agricultural Engineering Institute
D. J. Hills
Soil and Water, Vol. 10, No. 3, p. 32-36, March, 1974. 4 fig.

Descriptors: Waste disposal, Regulation, Confinement pens, Liquid wastes, Livestock, Poultry, Aeration, Irrigation, Lagoons, Agricultural runoff, Drying, Design, Water pollution.
Identifiers: Land disposal, Waste management, New Zealand.

Factors which have led to increasing use of confinement pens in New Zealand animal production are: competition for land, better control of animal health and nutrition, production of a consistent, high-grade product, requirement for less labor, and better adaptability to the development of the integrated operation. Confinement pen production of animals has changed the waste generation pattern from diffused to point-source, the waste transport form from solid to liquid handling, the waste processing from simple storage to rigorous treatment, the waste utilization from crop fertilizer to soil conditioner, and the waste disposal from a chore to a vexing problem. It has become almost imperative to treat animal wastes to stabilise them so they do not create an environmental nuisance or health hazard. Thus new waste management techniques have evolved. Management methods for piggeries, milking sheds, beef cattle feedlots and poultry houses are discussed. Projected trends for animal waste management in New Zealand are: (1) Piggery wastes will be mechanically aerated before land spreading. Some existing operations will utilize surface aerators floating in ponds. New operations will begin incorporation in-the-building oxidation ditches or external tanks with surface aeration. (2) Dairy shed wastes will continue to be disposed of by spray irrigation or anaerobic lagoons. Eventually, as water becomes a scarcer commodity, mechanical aeration will be required to treat the wastes. (3) Beef cattle feedlots are inevitable. Location of these must take into account runoff pollution following rain storms. (4) Poultry waste treatment will tend towards in-the-building drying techniques. (5) The ultimate disposal of wastes from all treatment systems will be to the land. (6) Waste disposal systems will be carefully integrated in the design stages of new livestock operations. (Edwards-East Central)

### 3473 - B1, C1, C2, C3, E3

### MICROBIOLOGICAL AND CHEMICAL SURVEY OF BEEF CATTLE WASTE FROM A NONSURFACED FEEDLOT,

Department of Biology, Texas Tech University, Lubbock, Texas 79409
D. W. Thayer, P. Lewter, J. Barker, and J. J. J. Chen
Bulletin of Environmental Contamination and Toxicology, Vol. 11, No. 1, p. 26-32, January, 1974. 2 tab, 7 ref.

Descriptors: Feedlots, Cattle, Chemical properties, Physical properties, Biological properties, Sampling, Microorganisms, Reclamation, Proteins, Microbiology.
Identifiers: Nonsurfaced feedlots, Climate.

This article discusses a study which was carried out on the average microbiological properties and selected chemical and physical properties of waste from a large nonsurfaced beef cattle feedlot in a semiarid climate. The purpose of the research was to define some of the major properties of the stockpiled manure prior to its potential use as a substrate for the production of single-cell protein. Under the discussion of materials and methods the following are covered collection on samples; media and culture conditions; chemical analysis; and sampling periods. Tabular results are presented on: viable microorganisms in feedlot manure and the chemical composition of feedlot manure. Another topic which is considered is the stockpile method of manure disposal, which is prevalent in the Southwest, and the attendant disposal and sanitation problems created thereby. (Solid Waste Information Retrieval System)

### 3474 - A11, A12, B3, C2, E3

### MILK PRODUCTION FROM A RATION CONTAINING DRIED POULTRY WASTE,

Great House Experimental Husbandry Farm
W. A. Kneale and J. R. Garstang
Experimental Husbandry, Vol. 28, p. 18-24, 1975. 8 tab, 9 ref.

Descriptors: Dairy industry, Feeds.
Identifiers: Refeeding, Dried poultry waste, Milk production.

Dried poultry waste was tested in rations fed to dairy cows during lactation. Autumn calving Friesian cattle were used in these experiments. Seven heifers were allocated per treatment in the first, 8 cows per treatment in the second and 16 cows per treatment in the third experiment. Roughage was supplied as hay and this was fed in an amount calculated to provide 85 percent of maintenance. It was found that the complete replacement of soya bean meal and groundnut meal by dried poultry waste tended to reduce milk output from cows fed this ration. The energy value of a ration containing 20 percent poultry waste was lower than that of a ration containing conventional vegetable protein. A 10 percent inclusion of poultry waste appeared to be acceptable in terms of milk production. When considering the use of poultry waste, the ash content of that waste should be determined before an inclusion rate is decided upon. The inclusion of poultry waste in a dairy feed was not a health hazard to those consuming the milk, neither did it produce tainted milk. (Cameron-East Central)

### 3475 - D2, E3

### A NOVEL CONTINUOUS PYROLYZER — THE TTU REPORT,

Department of Chemical Engineering, Texas Tech University, Lubbock 79409
H. W. Parker
Presented at the Rocky Mountain Regional American Chemical Society Meeting, Laramie, Wyoming, June 17-19, 31 p. 2 tab, 7 fig, 19 ref.

Descriptors: Pyrolysis, Pilot studies, Recycling, Oil.
Identifiers: Manure.

A variation of the Bureau of Mines Gas-Combustion Retort for oil shale has been developed which omits the troublesome internal gas distributor. This is accomplished by intermittent addition of air to the gas being recycled through the retort or by continuous small additions of air to the recycle gas. The 16 cm. diameter pilot retort has been operated at processing rates of $940\ \mathrm{kg/m^2}$ hr on 0.64 to 1.9 cm. manure particles containing 55 percent ash and 12.6 percent water. Results have shown that this retort can be operated to pyrolyze manure in both the cyclic and the continuous air injection modes. Capacity of the retort was established for continous air injection as 940 kilograms of feedlot waste/hour/square meter of retort cross section. The limited capacity of the recycle compressor prevented establishment of maximum processing for the cyclic mode of air injection, but it is assumed to be about the same. The continuous air injection mode of operation yielded less oil, and lower BTU product gas was observed for the cyclic air injection mode. The manure employed during the continuous air injection tests contained much more ash but less moisture than that used in the cyclic air injection tests. When the data were converted to yields based on moisture and ash free manure, the continuous air injection mode still produced much lower gas and liquid yields but higher char yields. Another factor which contributed to reduced yields of combustible gases in the continuous air injection mode was that the mixture of recycle gas and air which was injected into the retort was always fuel rich. (Rowe-East Central)

### 3476 - C2, D3, E3, F2
### POWER PLANT BOILERS TO BE FUELED BY COW MANURE,

Oklahoma Rural News, Vol. 27, No. 4, p. 7, November, 1976.

Descriptors: Recycling, Fuels, Methane, Feed, Fertilizers, Oklahoma, Legislation, Grants.
Identifiers: Anaerobic digesters.

Legislation under consideration by both the House and Senate in Washington, D.C. will,if successful, establish a study of anaerobic digesters for converting animal and vegetable wastes into methane gas and fertilizer. The legislation provides for a study of anaerobic digesters by the Soil Conservation Service in consultation with the National Bureau of Standards and the National Science Foundation. More than 100 farms of 640 acres or less throughout the U.S. would then participate in field performance tests. Those models rated most effective and safe would be "certified" and farmers would be eligible for grants for the installation of certified models. An Oklahoma City based firm isn't waiting for the legislation. Calorific Recovery Anaerobic Process, Inc., is building a plant in the Oklahoma Panhandle to convert cattle manure from 3 feedlots with a total capacity of 110,000 head, is scheduled to start in December, 1977. Approximately 600 million cubic feet of methane will be produced annually and will be sold to Natural Gas Pipeline Company of America for use in Chicago. Animal feed and fertilizer expected to be used locally by farmers will also be produced at the plant. (Merryman-East Central)

### 3477 - A11, C1, C2, C3, D2, E3, F3
### POULTRY WASTES AS A FEEDSTUFF FOR SHEEP,

Research Station, Agriculture Canada, P.O. Box 90,
Lennoxville, Quebec JIM 1Z3
P. Flipot, M. McNiven and J. D. Summers
Canadian Journal of Animal Science, Vol. 55, No. 3, p. 291-296, 1975. 5 tab, 17 ref.

Descriptors: Feeds, Waste treatment, Performance.
Identifiers: Refeeding, Sheep, Poultry manure.

A study was conducted to provide information concerning the acceptability and potential nutritive value of wet caged hen excreta when fed to mature sheep. Six wethers averaging 37 kg were used in a double 3 x 3 latin square design and were fed diets which contained approximately 64 percent (wet weight) poultry excreta. The excreta had been treated with tannic acid (3 percent) or with paraformaldehyde (2 percent). Soybean meal and water were used in the control diet. Dry matter and water intake of sheep fed this diet consumed less water and had correspondingly lower water excretion and percentage retention of water. Dry matter, total nitrogen, and energy digestibilities were significantly decreased in diets containing poultry excreta. Paraformaldehyde treatment significantly reduced the apparent digestibilities of dry matter and energy of the diet compared to the tannic-acid-treated diet. Nitrogen retained as a percent of total nitrogen intake was not significantly different for the control and the tannic-acid treated poultry excreta diet. Ensiling characteristics were not adversely affected by poultry excreta. The study data suggest that wet poultry excreta treated with tannic acid can be successfully used for the feeding of sheep. More work is required to find the most suitable additive to stabilize the chicken feces, and thus reduce odor and make the product more palatable. Work is also required on the risk of pathogenic organisms. (Rowe-East Central)

### 3478 - A4, A6, B1, D1, D2, D3, E2, F2
### PRESENT SITUATION AND PROBLEMS ON ENVIRONMENTAL PROTECTION AND CONSOLIDATION IN JAPAN,

Chemistry Laboratory, Tokyo University of Agriculture, Japan
K. Ishimaru
Reprinted from the Proceedings of the Symposium on Animal Research, Tropical Agriculture Research Center, Ministry of Agriculture and Forestry 2-2-1, Nishigahara, Kita-Ku, Tokyo 114, Japan, 1973, p. 147-162, 25 tab.

Descriptors: Water pollution control, Waste treatment, Legal aspects.
Identifiers: Japan, Odor control.

Increased livestock production has inevitably brought more stringent environmental protection laws in Japan. The Basic Law Environmental Pollution Control (Enacted in 1967, Law No. 132) regulates air pollution, water pollution, soil pollution, noises, osillation, land subsidence, mold and offensive odors. Of primary importance to animal husbandry are odors and water pollution. In Japan, odor intensities are measured and are required to meet certain standards. Odor control measures that may be utilized by livestock owners are: (1) Closure of barn and deodorization of enclosed odors, (2) Rinsing — Deodorization by channeling odor through a smoke duct or tower and then film-spraying with water, (3) Chemical treatment, (4) Oxidation, (5) Absorption, (6) Thermal decomposition, (7) Microorganism treatment by placing offensive smelling substance in microorganism growth culture, and (8) Soil treatment. Water must also be safeguarded. The Water Pollution Control Law requires that the purity of water in Japanese streams must comply with stipulated levels established for pH, BOD, COD, SS, and Coli. Treatment processes for animal wastes are discussed. Primary treatment methods outlined include: a storage tank, a solids removal apparatus, a sedimentation tank and settling tank, a simple digestion tank, and a sterilized tank. Secondary treatment processes outlined include: the activated sludge process and the trickling filtration process. While animal wastes make good fertilizers, the following must be considered when electing to use animal wastes in that manner: (1) farm size, (2) soil quality and composition, (3) kind of crops, (4) form and decay-rate of the fertilizer, (5) collection and treatment, (6) transportation and distribution, and (7) environmental and sanitation problems. (Merryman-East Central)

### 3479 - A8, B2, C2, E2
### RESIDUAL VALUE OF SLURRIES (CATTLE, PIG AND POULTRY),

N.A.A.S., Bristol
C. Berryman
Presented at NAAS Soil Scientists Open Conference, Paper SS/1/116, 1968, p. 326-332. 3 tab, 11 ref.

Descriptors: Slurries, Cattle, Poultry, Nitrogen, Potash, Phosphate, Crop response.
Identifiers: Land disposal, Land application, Swine, Residual values.

The lack of experimental work to measure the residual value of slurry gives rise to much difficulty when suggesting residual values of this type of manure. Factors which can influence the residual value are reviewed and an estimate of the residual value of nitrogen, phosphate, and potash in cattle, pig, and poultry slurries is given. There can be no finality about estimates of residual values because so much depends upon the farmer's skill in management and his particular method of farming. (Rowe-East Central)

### 3480 - B2, C1, C2, D3, E3
### ROTATING DISC PROCESS TREATS SLAUGHTERHOUSE WASTE,

Oklahoma State University, Stillwater
E. L. Stover and D. F. Kincannon
Industrial Wastes, Vol. 22, No. 3, p. 33-35, May/June, 1976. 5 fig.

Descriptors: Waste water treatment, Recycling, Aeration, Chemical oxygen demand, Temperature, Dissolved oxygen, Effluents.
Identifiers: Slaughterhouse wastes, Rotating biological reactor, Paunch manure.

The rotating biological reactor can successfully treat slaughterhouse-meatpacking wastes. Blood, grease, and paunch manure constitute the major problems. Recovery of these three products greatly reduces undesirable contents of the waste-water and can also be profitable in large slaughterhouses. Dried blood can be used for livestock feed, plywood adhesive, fertilizer ingredients, or as a protective colloid. In most of the smaller slaughterhouses, recovery practices are not incorporated, therefore, the wastewater consists of a mixture of blood, grease, paunch manure, and washwater. The rotating biological reactor requires a minimum amout of space. The rotating polystyrene disc system is noiseless, easy to operate, and requires a minimum of maintenance and power. The rotating discs are partially submerged, and the microbial population is alternately passed through the air and the wastewater. The discs provide media for the support of a fixed microbial growth, contact the growth with the wastewater, and aerate the wastewater to provide the dissolved oxygen necessary to maintain aerobic biological activity. The rotating disc used in this study was a four-ft. long, ten-gallon capacity unit built specifically for experimental purposes. Some experiments were carried out at a hydraulic loading of 0.5 gpd/ft. and varying organic loadings of slaughterhouse wastewater. Approximately 50 percent of the total COD removed occurred in the first stage of the unit. The substrate removal rates decreased and approached a constant minimum value as the applied organic loading was increased. A COD removal efficiency of 80 percent was achieved at a loading of 0.004 lb COD /day/ft. As the organic loading increased, the removal efficiency decreased and approached a constant minimum value. At loadings of 0.039 lb COD /day/ft. and greater, only ten percent COD removal was obtained by the unit. As the wastewater passed through the unit it increased in pH. A temperature drop of 25 degrees F was noted between the influent and effluent wastewater. There was an oxygen utilization of approximately 1 mg/l above that supplied by the unit. Therefore, oxygen utilization did not restrict the removal efficiency of the unit. (Rowe-East Central)

### 3481 - B3, F1
### EFFECTIVE MANURE HANDLING: TIME-MOTION FOCUS ON FEEDLOT WASTE EFFICIENCY,

Texas A&M University
J. M. Sweeten
Feedlot Management, Vol. 18, No. 5, p. 22-25, 28, May, 1976. 8 fig, 1 tab.

Descriptors: Efficiencies, Solid wastes, Management, Feedlots, Equipment, Costs, Productivity, Texas.
Identifiers: Time-motion studies, Manure collection, Elevating scraper, Wheel loader, Energy consumption.

A time-motion study of manure collection was conducted at 4 feedlots (ranging from 28,000 to 100,000 head capacity) in the Texas Panhandle. Collection systems included elevating scraper, wheel loader, and wheel loader plus plowing or rototilling. Major objectives were to compare machine productivity (tons manure/hour), energy consumption (tons/hp/hour) and cost (dollars/ton) for both collection and loading phases of solid manure handling. It was found that the elevating scraper had a lower energy requirement and slightly lower cost than wheel loaders operated with or without the benefit of pre-plowing or rototilling of the manure pack. In addition, the elevating scraper and the wheel loader chisel plow combination yielded the highest productivity (175 tons/hour). (Merryman-East Central)

## 3482 - B1, B4

### SWINE PRODUCTION AND HOUSING IN CALIFORNIA,

Tulare County Farm Advisor, California
R. F. Miller and W. J. Van Riet
Leaflet 2761, Division of Agricultural Sciences, University of California, September, 1975, 15 p. 36 fig.

Descriptors: California, Management, Waste storage, Waste disposal.
Identifiers: Swine, Housing.

Guidelines are given for establishing swine production facilities in California. Topics of discussion include: planning a swine production unit, production methods (pasture vs. confinement), stock selection and breeding, gestation and farrowing, care of baby pigs to weaning, growing and finishing, housing and space guidelines, and health and sanitation. (Merryman-East Central)

## 3483 - A8, A11, B3, C2, E2

### POULTRY MANURE: WASTE OR RESOURCE,

S. R. Wilkinson
Contribution from Soil, Water, and Air Sciences, Southern Region, Agricultural Research Service, U. S. Department of Agriculture, in cooperation with the University of Georgia Agricultural Experiment Stations, 1974, 4 p. 2 tab.

Descriptors: Litters, Fertilizers, Crop response.
Identifiers: Poultry waste, Land application, Application rates, Animal health, Pollution.

The value of poultry manure as a fertilizer and the use of land for litter disposal are examined. Plant nutrient content of poultry litter is variable and depends on its water content, the circumstances of flock management and production, and length and type of storage. Plant responses to nutrients present in high water content manures have been disappointing. Nitrogen in manures is generally not as readily available as nitrogen from commercial fertilizers. Utilization of poultry manure and litters as fertilizers or merely as a waste to be disposed of upon the land must be done under the constraints of maintaining a quality environment. Wise application of manure recycles nutrients to the soil, increases productivity, improves the soil, doesn't hurt the quality of water leaving the soil, and enhances a quality environment. Safe levels of broiler litter fertilization of fescue cut only for hay are about 8-10 tons acre. Four to five tons of broiler litter/acre/year is recommended for grazed pastures in order to prevent animal health problems of fat necrosis, grass tetany, nitrate toxicity and difficulty in fully using the grass grown. (Merryman-East Central)

## 3484 - A8, B1, C2, E2

### SOIL AND CROP RESPONSE TO APPLIED ANIMAL WASTE,

Research Assistant, Plant Science Department, South Dakota State University, Brookings
M. L. Horton, R. R. Schnabel, and J. N. Wiersma
Journal Paper No. 1431, South Dakota Agricultural Experiment Station, Brookings, 1975, 14 p. 2 fig, 6 tab, 11 ref.

Descriptors: Crop response, Salts, Diets, Infiltration rates, Soil properties, Cattle, Confinement pens, Feedlots.
Identifiers: Land application.

Research was initiated in August, 1973, which included feeding trials, field disposal plots, and laboratory analysis. The research was conducted to investigate the effects of various rates of applied wastes produced by animals on different rations upon soil properties and crop production under sub-humid conditions where minimum amounts of leaching water are available. Beef steers from confinement pens (11 head/pen) and 8 pens in the open with no shelter (11 head/pen) were fed a common basic ration with 4 levels of added salt — 0.00, 0.25, 0.50, and 0.75 percent of the ration on a dry-weight basis. All wastes were collected, stored until time of application, and applied to field disposal plots at 4 rates (44.8, 89.6, 139.4 and 179.2 MT/ha). The applied wastes consisted of 2 salinity levels — low (combined wastes from pens receiving 0.50 and 0.75 percent added salt). Laboratory analyses were performed on waste samples collected at the time of field application, on soil samples collected at planting and harvest, and on plant samples collected at tasseling stage. An infiltration study was conducted on half of the plots during the period July 6 to July 18, 1975. Results confirmed that application of animal waste to certain soils under conditions of minimal leaching can increase the salinity to levels harmful to the growth of many plants of agronomic importance. Applications of animal waste in excess of 90 MT/ha caused reduced infiltration. The cause of decreased water infiltration appeared to be increased sodium levels and dissolution of organic matter. (Merryman-East Central)

## 3485 - B2, C1, C2, D3

### RHEOLOGY OF LIVESTOCK WASTE SLURRIES,

Research Leader, U. S. Meat Animal Research Center, Clay Center, Nebraska
A. G. Hashimoto and Y. R. Chen.
Transactions of the ASAE, Vol. 19, No. 5, p. 930-934, September-October, 1976. 1 fig, 7 tab, 10 ref.

Descriptors: Rheology, Slurries, Equations, Aeration, Pumping, Mixing.

Study objectives were: (1) to identify a parameter that would mathematically describe the rheological properties of aerated and fresh dairy, poultry and swine waste slurries and that could be easily and precisely measured experimentally; and (2) to describe the procedures to estimate the effect of rheological properties on pumping, mixing, and aerating livestock waste slurries. The study showed that the rheological consistency index (k) and rheological behavior index (n) of livestock waste slurries can be expressed in terms of the equilibrium sludge volume fraction ($\Phi L$) as: $K = b_1 \Phi L^{b_2}$ and $n = b_3 + b_4 \ln \Phi L$ where $b_1$ to $b_4$ were determined for aerated and fresh dairy, poultry and swine waste slurries, and were found to be different depending on the range of $\Phi L$. The relationships between K and n to the effective viscosity ($\mu e$) and generalized Reynolds number ($^{N}Re$) have been described along with the effect of $\mu e$ and $^{N}Re$ on mixed power characteristics, oxygen transfer efficiency, and pressure headloss in pipeline transport of slurries. The centrifugation method to determine $\Phi L$ is also described. (Merryman-East Central)

## 3486 - A6, B1, C2, D2

### REMOVAL OF GASEOUS AMMONIA AND METHYLAMINE USING OZONE,

Assistant Professor, Agricultural Engineering Department, University of Florida, Gainesville
D. T. Hill and C. L. Barth
Transactions of the ASAE, Vol. 19, No. 5, p. 935-938, 944, September-October, 1976. 4 fig, 2 tab, 12 ref.

Descriptors: Ammonia, Ozone.
Identifiers: Odor control, Methylamine, Animal health.

Some of the basic properties of ozone-ammonia and ozone-methylamine reactions were investigated when using ozone as an oxidant for odor removal. Specific objectives were: (1) to determine whether ozone requirements for reduction of odorant concentration can be predicted by stoichiometric relationships and (b) to determine the ozone dose-contact time relationship for effective ammonia methylamine removal. Ozone was found to be an effective oxidant for both compounds studied, if given enough time. However, the relatively long contact times that are needed for ammonia and methylamine removal from odorous atmospheres in animal production facilities make the process appear to be of questionable value. The fact that these atmospheres contain many more diverse and chemically active compounds that would compete with the ammonia and methylamine for the ozone suggests that the contact time for effective ammonia and methylamine removal would be longer than observed in the investigation. The physiological effect on the animals by the ozone would prohibit this. One solution to the problem would be to exhaust the atmosphere of the production unit with a fan. If odor problems occurred because of close proximity to neighbors, ozone could then be employed to abate the problem. (Merryman-East Central)

## 3487 - B1, F1

### NETWORK ANALYSIS FOR DAIRY WASTE MANAGEMENT ALTERNATIVES,

Agricultural Engineering Department, Cornell University, Ithaca New York
L. M. Safley, Jr., D. R. Price, and D. C. Ludington
Transactions of the ASAE, Vol. 19, No. 5, p. 920-924, September-October, 1976. 3 fig, 2 tab, 17 ref.

Descriptors: Computer programs, Management, Dairy industry, Waste treatment, Waste disposal, Economics.
Identifiers: Network analysis.

Network analysis was applied effectively to the problem of determining the economic cost of dairy waste handling. Eleven freestall waste handling systems were defined and compared on the basis of a given set of input parameters. The network developed was analyzed on the basis of initial construction cost and yearly operational cost. A computer program was written to facilitate the computation. The program was constructed so that it might be easily adapted to new systems. It is felt that providing analysis for decision making on waste management alternatives has been partially met with the network analysis tool. The analysis tool was developed for use by extension personnel to assist farmers in selecting a system best suited to their specific farm operation and location. Additional inputs are needed to improve the usefulness of network analysis, such as benefits from manures for fertilizers, labor requirements, and odor control. (Merryman-East Central)

## 3488 - A6, B1, C2, F6

### QUANTITATIVE PREDICTION OF ODOR INTENSITY,

Assistant Professor, Agricultural Engineering Department, University of Florida, Gainesville
D. T. Hill and C. L. Barth
Transactions of the ASAE, Vol. 19, No. 5, p. 939-944, September-October, 1976. 2 fig, 6 tab, 12 ref.

Descriptors: Equations, Ammonia, Hydrogen sulfide.
Identifiers: Odor control, Odorant concentration, Odor intensity, Methylamine.

An investigation was made of the relationship of odor intensity, of odorant mixtures and individual odorant concentration using hydrogen sulfide, ammonia, and methylamine, common odorants in animal production facilities. Mathematical equations were developed to measure three, two-odorant mixtures and one, three-odorant mixture and it was found that they sufficiently quantified the relationship between pure odor components. The empirically derived prediction equations all contained a linear term and an exponential term, and extremely complex coefficients. The complexity of these equations would increase when greater numbers of odorants are involved. It was felt that controlling one odorant emitted in waste treatment process could provide significant odor reduction by limiting the odorant interactions of addition of synergism. Controlling one odorant would be easier than controlling all or most of the significant odorants present. (Merryman-East Central)

### 3489 - A8, B1, C2, E2

### AMMONIA VOLATILIZATION AND NITROGEN TRANSFORMATIONS IN SOILS USED FOR BEEF MANURE DISPOSAL,

Research Agricultural Engineer, Environmental Effects Laboratory, Waterways Experiment Station, U.S. Army Corps of Engineers, Vicksburg, Mississippi
R. E. Peters and D. L. Reddell
Transactions of the ASAE, Vol. 19, No. 5, p. 945-952, September-October, 1976. 5 fig, 6 tab, 24 ref.

Descriptors: Waste disposal, Ammonia, Nitrogen, Soil chemical properties.
Identifiers: Land disposal, Volatilization, Cattle manure.

A soil column installation was used in studying ammonia volatilization and nitrogen transformations when a large application of beef manure is incorporated into the soil. Limed ($pH = 12$) and unlimed ($pH = 7.5$) soil columns were incubated for 30, 60 and 90 day periods. Ammonia volatilization was found to be much greater from the high pH treatment while carbon dioxide evolution was much lighter from the low pH treatment. Approximately 10 percent of the total nitrogen from the low pH treatment was lost while a 20 percent loss occurred in the high pH treatment. (Merryman-East Central)

### 3490 - D3, E3, F1, F6

### MANURE-METHANE CONVERSION BEING STUDIED IN WEST,

Feedstuffs, Vol. 48, No. 47, p. 16, November 15, 1976.

Descriptors: Recycling, Fuels, Methane, Feedlots, Anaerobic digestion, California.
Identifiers: Cattle manure, Sanitary landfill.

Pacific Gas & Electric Co. and Southern California Gas Co. are spending $50,000 to study the potential conversion of cattle manure into methane. The study should take 6 months. It is expected that an estimated 30 million cubic feet of methane a day could be produced in Imperial, Fresno, and Kern counties. The main methane conversion process being examined involved anaerobic digestion. Also, Pacific Gas is working with Mountain View, California, and the Environmental Protection Agency in a joint project to see if methane can be extracted from the 544-acre Mountain View sanitary landfill. (Merryman-East Central)

### 3491 - B1, C1, F6

### PIPELINE TRANSPORT OF LIVESTOCK WASTE SLURRIES,

Agricultural Engineering Department, Cornell University, Ithaca, New York
Y. R. Chen, and A. G. Hashimoto
Transactions of the ASAE, Vol. 19, No. 5, p. 898-906, September-October, 1976. 7 fig, 7 ref.

Descriptors: Slurries, Equations, Rheology, Reynolds number.
Identifiers: Pipeline transport, Fanning friction coefficient.

A study was undertaken to find the correlation between the Fanning friction coefficient (f) of slurries flowing through 7.42 and 4.80 cm ID aluminum irrigation pipes. The $N'_{Re}$ (Reynolds number) were based on the rheological properties of the slurries measured by a capillary tube viscometer. The applicability of using rotation viscometer data in calculating $N'_{Re}$ was also discussed. In the laminar flow region, the experimental results closely followed $f \approx 16\ N'_{Re}$. For livestock waste slurries, the laminar flow region ended at $N'_{Re} \approx 3100$ and the fully developed turbulent region began at $N'_{Re} \approx 4300$. The $f - N'_{Re}$ correlation for livestock waste slurries with n' between 0.4 and 1 and $4300 < N'_{Re} < 10^5$ was $f = 0.0306\ (N'_{Re}) - 0.18$. In these equations, f = fanning friction coefficient, dimensionless; $N'_{Re}$ = generalized Reynolds number for non-Newtonian liquids, dimensionless; n' = rheological behavior index from capillary viscometer, dimensionless. (Merryman-East Central)

### 3492 - A6, A8, B1, C2, D1, D2, D3, E2

### OHIO SWINE WASTE SYSTEM SHOWS LESS POLLUTION ODOR,

J. D. Kendall, ed.
Feedstuffs, Vol. 47, No. 12, p. 13-14, 27, March 24, 1975.

Descriptors: Waste treatment, Waste disposal, Waste storage, Physical treatment, Chemical treatment, Biological treatment, Chlorine.
Identifiers: Odor control, Land disposal, Application rates, Hydrogen peroxide, Sodium hypochlorite, Potassium permanganate.

E. P. Taiganides of Ohio State University discussed a three-year test of a complete automated waste treatment system on a pig farm in Botkins, Ohio, in which there was no water pollution and a minimum of odor nuisance. The treatment system included (1) hydraulic removal of wastes in the building by flushing gutters with liquids from overhead siphon tanks and tipping buckets; (2) primary treatments consisting of a stabilization of solids, solids storage tanks and final disposal of settled solids on farm land; (3) secondary treatment, consisting of an oxidation ditch, final clarifier and re-use of clarifier effluent as flushing liquid in the building, and (4) tertiary treatment, consisting of a laboratory evaluation of the use of high-pressure-driven membranes for the removal of chemical nutrients from the clarifier effluent. Control of odor from stored liquid swine wastes by means of various chemical and biological compounds was also discussed in terms of the work undertaken by Pennsylvania State scientists C. A. Cole, H. D. Bartlett, D. H. Buckner, and D. E. Younkin. In short-term experiments, hydrogen peroxide, sodium hypochlorite, chlorine, and potassium permanganate, dosed at 500 ppm, greatly reduced sulfide and odor level in liquid swine manure. However, activated carbon dosed at even 5000 ppm was not as effective. In another study, Bartlett studied the effects of injecting waste slurry directly into crop land, thus avoiding the "lingering pungent odor" of slurry spread on top of the ground. Subsurface applications of liquid manure were shown to give complete control of odor problems at the spreading site; however, manure application rates should be limited to supply nitrogen not much in excess of the amount that the crops can assimilate. (Merryman-East Central)

### 3493 - A6, A7, B1, F2

### DEQ DEVELOPS RULES TO CONTROL ODORS,

J. Wiebel
Wallaces Farmer, Vol. 101, No. 20, p. 54, October 23, 1976.

Descriptors: Regulations, Legal aspects, Iowa, Feedlots.
Identifiers: Department of Environmental Quality, Odor control.

The Iowa Department of Environmental Quality's Air Quality Commission is evaluating proposed odor control regulations which may be passed, may be slightly modified, or which may be modified to such an extent that they have to once again be brought before a public hearing. According to the new regulations, when an odor complaint is filed, it would first be discussed before the local county board of health in hopes of circumventing legal action. Also, 2 types of permit programs were proposed for the new regulations. The first was a mandatory permit program in which anyone putting up a livestock facility that has a potential for odor problems has to have a permit. The other was that an optional permit program in which permits would not be required, but such permits would help in defense in event of complaints. Unless there are some hangups, some or all of the regulations being considered could go into effect this year. (Merryman-East Central)

### 3494 - A2, A4, B1, F2

### GOOD NEWS AND BAD IN FEEDLOT RUNOFF RULES,

J. Wiebel
Wallaces Farmer, Vol. 101, No. 20, p. 15, October 23, 1976.

Descriptors: Regulations, Legal aspects, Feedlots, Agricultural runoff, Water pollution.
Identifiers: Permits.

Iowa's new feedlot runoff regulations go into effect October 25, 1976. Sizes (minimum capacity) of open feedlots required to have permits are: beef cattle - 1000, dairy cattle - 700, swine (butcher and breeding over 55 lb) - 2500; sheep and lambs - 10,000, and turkeys - 55,000. Multipliers are given for computing animal units for feedlots of more than one species. A permit is needed by feedlots having more than 1000 animal units. Open feedlots as small as 100 beef cattle or the equivalent may need a permit if runoff enters a stream. The stream must be large enough to drain more than 3200 acres above the feedlot. Deciding factor is how far the runoff must travel to reach the stream in relation to feedlot size. For confinement feedlots, those where livestock are kept under roof and wastes are handled in liquid or semi-liquid form, capacity requirements for obtaining a permit depend upon the type of waste handling system used. A permit must also be obtained if wastes are discharged into a stream through a manmade drainage system such as a ditch, tile, or flushing system. Same capacities apply if a stream runs through the feedlot. Operations requiring permits under these circumstances have the following minimum capacities: beef cattle - 100, dairy cattle - 70, swine - 250, sheep - 1000, turkeys - 5000, and chickens - 9000. Feedlot owners may also be required to secure permits if they don't meet minimum control measures or they are polluting state-waterways. Feedlots requiring permits must apply for them by April 1, 1977. (Merryman-East Central)

### 3495 - A8, E2

### EFFECT ON SOIL AND PLANT MINERAL LEVELS FOLLOWING APPLICATION OF MANURE FROM SWINE FED HIGH DIETARY COPPER,

Department of Animal Science, Virginia Polytechnic Institute and State University, Blacksburg 24061
R. T. Kornegay, J. D. Hedges, D. C. Martens, and C. Y. Kramer
1973-1974 Livestock Research Report, Research Division Report 158, Virginia Polytechnic Institute and State University, Blacksburg, July, 1974, p. 129-134. 5 tab.

Descriptors: Diets, Copper, Fertilizers, Soil contamination, Crop response, Zinc, Potassium, phosphorus, Calcium, Magnesium.
Identifiers: Land application, Swine manure, Corn, Minerals.

Manure from pigs fed high dietary levels of copper was incorporated into a silty loam soil for 2 consecutive years to study its effects on soil and plant mineral levels. Average composition of the manure for both years on a dry basis was 3.66 percent nitrogen, 3.13 percent calcium, 0.94 percent magnesium, 2.53 percent phosphorus, 1.31 percent potassium, 763 ppm zinc, 2135 ppm iron. Wet manure each year contained about 22 percent dry matter. Results revealed that in general copper, zinc, potassium, calcium and magnesium accumulate in the surface layer of the soil until the soil is plowed, after which there is some increase in the layers. On the other hand, phosphorus moves downward, although the surface 4 inches retained the highest level. The copper content of the corn plant (ear leaf) was increased for corn grown on the plots receiving high copper manure;, however, there was no increase in the copper content of the grain. (Merryman-East Central)

## 3496 - A11, B1, C2, E3
### RESEARCH ON ORGANIC INDUSTRIAL BYPRODUCTS, RECYCLED MANURE FOR FEED REPORTED AT ANRC,

Feedstuffs, Vol. 44, p. 6, November 27, 1972.

Descriptors: Recycling, Feeds, Additives, Performances, Arsenic compounds, Cattle, Wood wastes.
Identifiers: Refeeding, Dairy cattle, Sheep, Liver abcess.

Five presentations to the 1972 annual meeting of the Animal Nutrition Research Council are reported. Dr. C. C. Calvert noted that one of the problems associated with the refeeding of animal manures is their contamination with feed additive residues. Animal waste research was done at Beltsville on arsenicals to determine whether the amount of arsenic from arsanilic acid and 3-nitro-4-hydroxphenylarsonic acid found in poultry manure and litter has any effect on the performance of sheep and dairy cows consuming them and whether residues are deposited in various tissues and milk. Such arsenic was fed to dairy cows at levels up to 32 mg As/kg of body weight for 5 days. Milk production and general health of the cows was not significantly affected. In experiments with sheep, results showed that 83-91 percent of the total ingested arsenic was excreted in urine and feces. Aresenic fed to sheep at levels of 30, 150, and 300 mg kg of diet for 28 days resulted in no clinical symptoms of arsenic toxicity in the sheep. Dr. L. B. Carew, Jr., reported on the subcommittee for metabolizable energy standards which divided the task of establishing standards into 4 categories: (1) analytical methods, (2) direct methods, (3) indirect methods, and (4) biological and environmental variables. Dr. Terry Klopfenstein and Bill Schneider reported that bovine hepatic necrobacillosis (liver abcess) is a frequently occurring condition in cattle fed high concentrate finishing rations. Several trials have indicated that rations which produce acidosis, such as those containing high levels of wheat, increase incidence of liver abcesses. Dr. M. R. Spivey-Fox, Food and Drug Adminstration, reported on programs for determination of key elements in U.S. foods and routes of some elements of the foods. Dr. David Dinius, noted that wood wastes are receiving increasing interest as a feedstuff for ruminants. The higher the digestibility, the greater the dietary percentage of wood residue that can be fed without adversely affecting animal performance. Energy is essentially the only available nutrient. (Merryman-East Central)

## 3497 - A11, B2, C2, D3, E3
### NUTRITIVE VALUE OF AEROBICALLY TREATED LIVESTOCK AND MUNICIPAL WASTES,

Department of Agricultural Engineering, University of Illinois, Urbana-Champaign
D. L. Day and B. G. Harmon
Environmental Protection Agency Report EPA-660/2-74-041, Wastewater Use in the Production of Food and Fiber — Proceedings, Oklahoma City, March 5-7, 1974, p. 240-255. 3 fig, 11 tab, 27 ref.

Descriptors: Aerobic treatment, Nutrients, Feeds, Amino acids, Performance.
Identifiers: Refeeding, Oxidation ditch mixed liquor, Crude protein, Lysine.

This paper reviews some of the major projects of analyzing the amino-acid content of aerobically treated sewage and livestock wastes and of evaluating the product as a protein supplement in the diets of livestock. Although the amino-acid content is similar for aerobically treated municipal wastes and livestock wastes, extraneous materials can be more closely controlled in livestock wastes than in municipal sewage. A method developed at the University of Illinois in recent years utilizes oxidation-ditch mixed liquor (ODML) in situ, supplying drinking water as well as protein and other nutrients. Crude protein in the ODML varies from 30 to 46 percent, the latter value is as high as in soybean meal. Also lysine and other amino acids essential to growth can be as high in concentrated ODML as in soybean meal. This method avoids the ordinary expenses generally associated with recycling. It also offers 2 obvious advantages: minimizing pollution and realizing a new source of nutrients. The present costs of soybean meal make the method economically feasible and energetically attractive. However, a more efficient method of oxidation is needed. Even so, the aerobic process offers possibilities for a least-cost method of waste management that has several advantages over alternate methods. Obviously, the acceptance of the use of this monocellular protein product in the diets of livestock will require some explanation and education. (Day-University of Illinois; Merryman, ed.)

## 3498 - A8, E2
### EFFECTS OF INTENSIVE APPLICATIONS OF LIVESTOCK MANURE ON SOIL AND CROPS,

Department of Agricultural Engineering, University of Minnesota
P. R. Goodrich, E. C. Miller, J. J. Boedicker, S. D. Evans, G. W. Randall, and A. E. Hanson
1973 Minnesota Cattle Feeder's Report, 1973 Research Report B-193, Department of Animal Science, University of Minnesota, p. 99-115. 18 tab.

Descriptors: Crop response, Soil dynamics, Nutrients.
Identifiers: Land application, Application rates, Corn, Livestock wastes.

In the summer of 1970, an interdisciplinary project was initiated involving many agricultural scientists within the Institute of Agriculture, University of Minnesota. Cooperating in the project were personnel from the experiment stations at Cookston, Grand Rapids, Morris, Rosemount, and Waseca. Objectives of the main project were to investigate problems associated with: (1) The heavy annual application and incorporation of manure. (2) The downward movement of nutrients following the application of manure. (3) The capacity of land to serve as a disposal medium for manure. (4) The response of corn to manure applications. The manure rate study was implemented after information was gained from several pilot studies started in 1970. Annual applications of manure at 3 rates were made to soil cropped each year to corn. Results are given for the ongoing experiments which are taking place at the 5 experiment stations listed. (Merryman-East Central)

## 3499 - B2, C1, C2, E2, E3, F1
### THAT MANURE PIT: IS IT A GOLDMINE?,

Managing Editor, Agricultural Engineering
M. Pratt
Agricultural Engineering, Vol. 56, No. 6, p. 19, June, 1975

Descriptors: Recycling, Liquid wastes, Fertilizers, Fuels, Methane, Nutrients, Economics, Cattle.
Identifiers: Oxidation ditch mixed liquor, Refeeding Swine, Dairy cattle.

Five experts discussed practical manure handling and utilization techniques at an open forum session moderated by WGN-TV farm service director Orion Samuelson. Jim Converse, University of Wisconsin, stressed the need to look at the net energy retrieved from a manure utilization system rather than to look at gross energy possibilities only. This may make such recycling into energy less attractive. While converting animal wastes into energy seems impractical now, when our fossil fuel supplies start to dwindle, it may become a viable alternative. Bill Kline, owner of Agrilabs, Inc. described his firm's program to sell deodorized liquid manure as a soil additive. There is even a possibility of shipping the liquid manure to developing nations in the tankers that bring petroleum to U.S. ports. John Eldon and Rodney Bisnich described the system used at Eldon Farms, where hogs in the finishing house are brought to market weight consuming liquid from their own wastes as their only water source. Eldon Farms presently recycles oxidation ditch mixed liquor to about 180 hogs of the 450 kept in the finishing house at one time. Don Jedele, University of Illinois, described the feedlot operation of Larsen & Taylor Feedlots in DeKalb County, Illinois, where manager Ray Larsen handles 1340 cattle at a time, with 2¼ herds a year — which adds up to about 2.5 million gallons of manure a year. This manure is spread on the land to utilize its fertilizer value. Larsen estimates the manure value as fertilizer is $9.56 per animal raised. At least 400 head would be required to justify the expense of the tankwagon and pump. Larsen figures 34 man-days are needed yearly in the spreading operation. (Merryman-East Central)

## 3500 - A3, A4, B1, F1, F2
### PLANNING LAND FOR REDUCTION OF NON-POINT SOURCES OF WATER POLLUTION,

Associate Professor, Agricultural Engineering Department, Purdue University, West Lafayette, Indiana 47907
R. Z. Wheaton
Presented at the 1976 Annual Meeting, American Society of Agricultural Engineers, University of Nebraska, June 27-30, Paper No. 76-2078, 6 p.

Descriptors: Legal aspects, Planning, Agricultural runoff, Economics.
Identifiers: Water Pollution control, Land planning, Non-point sources.

Planning to achieve land treatment is reviewed based on experiences resulting from a project in northeastern Indiana whose major objective was to reduce sediments and related pollutants in agricultural runoff for improvement in water quality. As a result of these experiences, the following conclusions were drawn: (1) Non-point pollution control will involve treating private land for public benefit. (2) Public information programs should be started early. (3) The public should be kept informed throughout all phases of planning. (4) Planning should be kept as close to the people as possible. (5) It is necessary to work through community leaders. (6) Planning to achieve adequate land treatment will require several times the technical assistance now available. (7) Some type of cost share and other incentive programs will be needed. (8) The planner must be flexible to adapt his technology to the needs. (9) Many practices will involve groups instead of individual land owners. (10) Acceptance of certain practices may be slow but once accepted, their application may proceed rapidly. (11) Some individuals who are reluctant at first may become willing cooperators after a year or two. (12) Demonstrations are effective selling tools. (13) A program for maintenance should be built into the plan. (14) The land owner must have assurances that he is in compliance regardless of the occurence of major hydrologic events. (15) Cost share and similar incentives will not achieve complete land treatment. (16) The goals must be practible, obtainable and at a cost that society is willing to pay. (Merryman-East Central)

## 3501 - B2, B3, C2, D1, E2, E3, F1
### SUCCESSFUL RECYCLING CALLS FOR COMBINATION OF GOOD MANAGEMENT, CARE AND PROCESSING OF WASTE,

Director of Engineering, Agpro, Inc.
D. J. Gribble
Beef, Vol. 12, No. 9, p. 32-35, May, 1976. 6 fig.

Descriptors: Recycling, Separation techniques, Solid wastes, Liquid wastes, Irrigation, Fertilizers, Economics, Performance.
Identifiers: Refeeding, Land disposal, Flushing.

Cattle waste reclamation has potential for solving several current pressing problems and for showing substantial return on the investment while doing it. A system that helps improve sanitation and cleanliness, reduces the labor required to clean up, store and dispose of manure, meets current and projected EPA requirements, and provides enough reclaimed feed to pay its own way, is certainly timely in light of current regulations and feed costs. An example of such a system may be found in a recent research study at the University of North Carolina where solids reclaimed from manure slurry were refed to Jersey steers in a ration consisting of one part reclaimed solids to two parts silage concentrate mix. The calves maintained an average gain of 1.9 pounds/day on the ration. The analysis of the total ration indicated the silage and concentrate mix could be expected to support an average daily gain of 0.8 pounds. The difference (1.1 pounds/day) was attributed to the presence of screened manure solids in the ration. It was found that remaining liquid wastes could be applied to croplands by means of sprinkler irrigation or could be reused as flush water within the livestock facility. (Merryman-East Central)

### 3502 - B1, B2, B3, E2
### TOTAL WASTE HANDLING FROM 100 COWS IN FREE STALL,

Associate Professor, Agricultural Engineering Department, Cornell University, Ithaca, New York
R. W. Guest and W. W. Irish
Presented at the 1972 Annual Meeting, North Atlantic Region, American Society of Agricultural Engineers, University of Maryland, August 13-15, 1972, Paper No. NA72-402, 6 p. 1 fig.

Descriptors: Dairy industry, Management, Liquid wastes, Solid wastes, Waste storage, Waste disposal.
Identifiers: Land spreading, Waste collection.

Basic components of waste handling systems are collection, transfer, storage, processing and disposal. Basic criteria for dairy waste management are: (1) All waste must be removed from dairy housing units daily. (2) Spreading during the snow season and intense rainy periods should be minimal. (3) Interference with peak labor periods should be minimal, (4) Labor must be minimized (Automation maximized). (5) Waste utilization by crops should be maximized. (6) Air and water pollution must be minimal. (7) Conservation of water should be practiced. A dual system with liquid and dry waste handling is proposed and alternative management methods are given. (Merryman-East Central)

### 3503 - A2, B2, D1, D3
### "SINK" "ZIG-ZAG WATERWAY" FOR FEEDLOT RUNOFF CONTROL,

Nebraska Farmer, Vol. 117, No. 13, p. 29, July 5, 1975.

Descriptors: Agricultural runoffs, Feedlots, Water pollution, Nebraska.
Identifiers: Runoff control, Field sink, Switchback waterway, Debris basin.

Three U.S. Department of Agriculture, Agricultural Research Service Engineers at the University of Nebraska have come up with 2 systems for handling feedlot runoff without holding ponds. One is the "field sink", a flat disposal area adjacent to the feedlot, where the sink can remain under cultivation. This system, which is being tried at a feedlot near Springfield, Nebraska, is 160 by 325 feet, an area about 85 percent as large as the feedlot from which the runoff is received. The runoff is first accumulated in a debris basin in the feedlot with many of the solids settling out in the basin as the liquid flows out through an intake riser and into a buried tile line. The other system is the "switchback waterway", a zig-zagging grassed waterway with a gradual grade, providing a long runoff flow-route within a small area. This system is being tested at a 3-acre feedlot near Gretna, Nebraska. Runoff from the feedlot first passes through debris basins before entering the serpentine grassed waterway. Within an area that separates the feedlot and a stream by a distance of about 400 feet, this meandering waterway with its 8 hairpin turns carries runoff over a 2,600-foot route. It is estimated that the waterway will control feedlot runoff during about 80 percent of the rainstorms in Eastern Nebraska. (Rowe-East Central)

### 3504 - A11, B3, C2, E3
### USE OF POULTRY MANURES IN STEER FINISHING RATIONS,

Director of Feed Research, Gold Kist Research Farm, Talmo, Georgia
A. E. Cullison, H. C. McCampbell, A. C. Cunningham, R. S. Lowrey, E. P. Warren, B. D. McLendon, and D. H. Sherwood
Journal of Animal Science, Vol. 42, No. 1, p. 219-228, January, 1976. 8 tab, 16 ref.

Descriptors: Performance, Recycling.
Identifiers: Refeeding, Poultry wastes, Steer finishing rations, Crude protein.

Two feeding trials involving 70 and 110 steers, respectively, were carried out. The first trial was to study the use of different levels of pure dried broiler excreta as a protein source in steer rations. The second trial was conducted to compare broiler manure with a wood shavings base, broiler manure with a peanut hulls base and dried layer hen manure as steer ration components. The dried broiler excreta contained 34.5 percent crude protein (dry basis). The other 3 diets contained, in respective order, 22.5, 24.9, and 40.4 percent crude protein. When dried broiler excreta was fed to provide either one-half or all of the supplemental protein in steer finishing rations, weight gains were not significantly different from those obtained with the control ration; however, there was a tendency for daily weight gains to decrease as the level of broiler excreta in the ration increased. Steers receiving 20 percent broiler manure/wood shavings and 2 percent cane molasses in place of the control ration (containing 12.5 percent peanut hulls and 1.5 percent minerals) performed in every parameter studied, including taste panel evaluations, as well as or better than steers on the control ration. In a similar experiment, broiler manure/peanut hulls did not give a comparable performance until additional roughage was provided. Rations containing dried caged layer hen manure yielded lower rates of gain than rations containing broiler manure. Steers receiving a negative control ration containing no protein supplement were found to gain faster than steers receiving supplemental protein in the form of dried hen manure. (Rowe-East Central)

### 3505 - B3, B4, B5, C2
### STABILITY OF POULTRY ANAPHAGE,

Department of Poultry Science, Michigan State University, East Lansing 48824
T. S. Chang, D. S. Dorn and H. C. Zindel
Poultry Science, Vol. 53, No. 6, p. 2221-2224, 1974.

Descriptors: Waste storage, Nutrients, Calcium, Phosphorus, Moisture content, Kjeldahl nitrogen.
Identifiers: Poultry anaphage, Crude fiber, Ether extract, Non-protein nitrogen.

Poultry anaphage was analyzed for calcium, phosphorus, crude fiber, ether extract, moisture, Kjeldahl nitrogen and non-protein nitrogen immediately at the time of sampling and after storage of 15 to 54 weeks. Results showed that the nutrients in the anaphage were stable during storage. (Rowe-East Central)

### 3506 - A3, C2
### SAMPLING PROCEDURES FOR NITROGEN AND PHOSPHORUS IN RUNOFF,

Soil Scientists, U. S. Department of Agriculture, Columbia, Missouri
R. E. Burwell, G. E. Schuman, R. F. Priest, W. E. Larson, and E. E. Alberts
Transactions of the ASAE, Vol. 18, No. 5, p. 913-917, 1975. 2 fig, 5 tab, 10 ref.

Descriptors: Agricultural runoff, Sampling, Nitrogen, Phosphorus.
Identifiers: Storm nutrient discharges.

Surface runoff data collected from 2 corn-cropped watersheds in southwestern Iowa during a 5-year period were analyzed to evaluate sampling methods needed to determine storm discharges of $NO_3$-N, $NH_4$-N, inorganic P, sediment N (total kjeldahl N) and sediment P ($NaHCO_3$-extractable P). Three methods of averaging sample nutrient concentrations were described for calculating storm nutrient discharges, and these were compared with a standard integrated method. The arithmetic mean of nutrient concentrations for samples collected during major runoff multiplied by the quantity of water or sediment was superior to the all-sample mean and the three-sample methods for determining $NO_3$-N, and $NaHCO_3$-extractable P discharges. The three-sample mean method of calculation which involved only 3 samples collected at runoff rates greater than 0.28 $m^3$/sec (24 percent of total samples collected) was more favorable than the all-sample mean method for determining storm discharges of $NO_3$-N, $NH_4$-N, and sediment N. The three-sample mean method would probably give satisfactory accuracy for most surveys, with savings in field work and laboratory time. A storm-to-storm decrease of $NO_3$-N concentration was observed, indicating that each storm should be sampled or an accounting made for this decrease to quantify cropping season discharges of $NO_3$-N. Since this storm-to-storm effect was not evident for $NH_4$-N inorganic P, sediment N, and sediment P, sampling of each event would not be required for these parameters. Unsampled events could be estimated. (Rowe-East Central)

### 3507 - B2, C1, F6
### PIPELINE TRANSPORT OF LIVESTOCK WASTE SLURRIES,

Agricultural Research Service, USDA, Department of Agricultural Engineering, Cornell University, Ithaca, New York 14853
Y. R. Chen, and A. G. Hashimoto
Presented at the 1975 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, Dec. 15-18, 1975, Paper No. 75-4552, 19 p. 6 fig, 1 tab, 16 ref.

Descriptors: Slurries, Pipelines, Equations, Design, Density.
Identifiers: Rheological data, Livestock wastes, Total solids.

The friction coefficient for pipeline flow of livestock waste slurries was correlated to the generalized Reynolds number ($N'_{Re}$). The rheological property indicates K' and n', of the slurry were from the capillary viscometer. In the laminar flow region, the experimental results closely follow $f \approx 16/N'_{Re}$. For livestock waste slurries, the laminar flow region ended at $N'_{Re} \simeq 3100$ and the fully developed turbulent region began at $N'_{Re} \simeq 4300$. The f - $N'_{Re}$ correlation for livestock waste slurries with $4300 < N'_{Re} < 10^5$ was $f = 0.0306\ (N'_{Re})\ -0.18$. It was also found that the rheological data from rotational viscometer were useful in calculating $N'_{Re}$. For the slurry with low solids concentration and low flow rates, the solid particles could settle in the pipe. This could greatly increase the friction coefficient. It was found that the slurry density depended linearly on its solids concentration, for less than 10 percent total solids concentration. (Rowe-East Central)

### 3508 - A11, A12, B2, B3, C2, C3, D3, E2, E3, F1
### TWENTY-EIGHT PERCENT SAFE PROTEIN FROM BROILER LITTER,

R. Whipple
Broiler Industry, Vol. 34, No. 1, p. 38, 42-43, January, 1971.

Descriptors: Recycling, Diets, Proteins, Nutrients, Fertilizers, Cattle, Feedlots, Public health, Safety.
Identifiers: Refeeding, Broiler litter, Cattle wastes, Turkeys, Swine.

Research is being conducted at Busse-Hillstrom Research Farm at Cokato, Minneapolis, in which poultry litter is ensiled and refed to cattle and cattle manure is composted and refed to hogs. The poultry litter (wood shavings plus turkey broiler excreta) is ensiled in a sealed silo. After ensiling, the product is found to have 28 percent protein, 30 percent moisture, 36 percent fiber, 2 percent fat, 8½ percent ash and 1 percent phosphorus. The ensiled litter is fed to steers at a ratio of two-thirds poultry silage, one-third high moisture corn, plus a mineral supplement. The mineral supplement contains dicalcium phosphate, a trace of mineralized salt, and vitamins A and D. Wastes from the steers then go through a separation process in which solids are composted for a year for refeeding to hogs and the liquids are forwarded to a storage well for use on fields as fertilizer. Thus far, the refeeding of the poultry and cattle wastes has been found entirely safe. The elimination of a drying process for the wastes eliminates packaging, storage, and handling costs, thus increasing the economic benefits of such recycling. (Rowe-East Central)

## 3509 - A6, C2

### URINE AND FECES EFFECT ON $NH_3$ AND ODORS FROM BOVINE WASTE,

Department of Animal Science, University of Hawaii, Honolulu, Hawaii 96822
R. O. Kellems, D. C. Church, and J. R. Miner
Proceedings, Western Section, American Society of Animal Science, Vol. 27, 1976, 3 p. 4 tab.

Descriptors: Odor, Ammonia, Urine, Sampling.
Identifiers: Feces, Cattle wastes, Olfactory panel.

Experiments were conducted to evaluate: (1) the relationship between ammonia generation rates and objectionable odors and (2) the effect of urine, feces, and length of storage on ammonia production from bovine waste. Feces and urine samples were collected from 5 Holstein heifers that were fed a ration of 25 percent barley and 75 percent alfalfa hay. From the composite samples of urine and feces, the following samples were prepared: 100 g urine, 50 g feces + 50 g water, 50 g feces + 50 g urine, and 25 g feces + 75 g water. The samples were incubated at 30°C for 24 hours prior to being evaluated by an olfactory panel. Rates of ammonia release for each of the various samples were determined prior to presentation to the olfactory panel. The initial numerical rating and ranking values for relative offensiveness were not found to be noticeably different for the samples evaluated. This would indicate that the relative portions of feces, urine, and water have little effect upon the initial release of odoriferous compounds. A negative correlation for the fecal content and a positive correlation for urine with respect to ranking were observed. Ammonia release rates were positively correlated with urine content of the samples. The water and fecal content were negatively correlated with the initial release of ammonia. Samples containing urine generated more ammonia than samples containing only feces and water. In a second experiment, fresh feces and urine were collected from Holstein heifers fed 25 percent barley and 75 percent alfalfa hay. Samples prepared from the composite samples of feces and urine were: 100 percent feces, 100 percent urine, 50 percent feces + 50 percent urine, 75 percent feces + 25 percent urine, 75 percent feces + 25 percent water, 50 percent feces + 50 percent water, 25 percent feces + 75 percent water, and 5 percent feces + 95 percent water. The samples were maintained in a water bath at 30°C for 25 days. Ammonia evolution rates of the samples were determined. Urine was found to be primarily responsible for the initial release of ammonia. Feces had little effect. (Rowe-East Central)

## 3510 - A8, B2, E2

### NEW IRRIGATION SYSTEM MAY ELIMINATE PROBLEM OF LIVESTOCK WASTE DISPOSAL,

Beef, Vol. 13, No. 3, p. 12, 14-15, November, 1976. 2 fig.

Descriptors: Irrigation, Equipment, Design, Economics, Costs, Slurries, Fertilizers, Liquid wastes.
Identifiers: Land application.

Valmont Industries has come up with a new livestock waste irrigation system which alleviates past problems of clogged lines and nozzles and uneven distribution. Their new irrigation system utilizes a one wheel-and-support unit with a boom that is only 185 feet long. When the boom rotates, it covers a 10-acre area with liquid manure. The waste system has far more capacity than is needed by most operations for just manure handling. The leftover capacity may be used to provide standby and supplemental irrigation — a practice which can pay big dividends even in the usually-moist Cornbelt. The unit will cost between $9,000 and $10,000. To that must be added the cost of a gas-driven power generator, plus the cost of pipe and the pump. Purdue Agricultural engineer John Nye estimates that the system takes about one man-hour per 10 acres to handle the center pivot. Besides reduction in labor, two other advantages of the system are that manure may be spread in any weather and the system may be used to apply irrigation water on top of the spread slurries to carry the fertilizer down into the ground. Nye does not recommend applying the wastes to growing crops. (Merryman-East Central)

## 3511 - B2, C1, C2, D2, D3, E3, F1, F6

### PROCESS FEASIBILITY STUDY: THE ANAEROBIC DIGESTION OF DAIRY COW MANURE AT THE STATE REFORMATORY HONOR FARM, MONROE, WASHINGTON,

Ecotope Group (Research Consultants)
Process Feasibility Study: The Anaerobic Digestion of Dairy Cow Manure at the State Reformatory Honor Farm, Monroe, Washington, Ecotope Group, January, 1975, 119 p. 25 fig, 23 ref, 6 appendices.

Descriptors: Feasibility studies, Anaerobic digestion, Recycling, Costs, Washington, Gases, Fertilizers, Fuels, Design, Confinement pens, Management.
Identifiers: Dairy manure.

A feasibility study has been completed. Manure from 350 cattle units (one cattle unit=1000 pound animal) dairy operation will be scraped from loafing shed and deposited into the digestor to produce a combustible gas and ammoniated nitrogen fertilizer. Digestor tanks will be an existing product which can be purchased at a reasonable cost. Digestion technique will utilize high rate gas recirculation mixing. Net production (after heating needs) of bio-gas (600BTU/cu ft) was estimated to be 7500 to 9500 cu. ft./day in cold and warm seasons respectively. Bio-gas will be used to reduce consumption of #2 fuel oil. BTU replacement savings is estimated to be $4488.00/year. Fertilizer earnings are based on transformation of organically bound nitrogen to the ammoniated form. This was estimated to be 8 tons/year for earnings of $6344.00/year to reduce consumption of ammoniated nitrogen fertilizer. Total direct cost of system was estimated to be $56,700.00. Evaluation of scale of project shows the amortized cost per cattle unit is near the break-even point for investment payback from bio-gas earnings alone. (Ecotope Group)

## 3512 - A2, A4, B2, E2, F1, F6

### WASTE WATER IRRIGATION,

Feedlot Management
Lamp, staff editor
Feedlot Management, Vol. 18, No. 8, p. 7-8, 10, 13, 14, August, 1976. 5 fig.

Descriptors: Agricultural runoff, Water pollution, Feedlots, Grants, Irrigation, Liquid wastes, Crop response, Fertilizers.
Identifiers: Runoff control, Holding ponds. Debris basins, Land application.

L. P. Schram Feedlot, Inc., Papillion, Nebraska, was thought to pose a threat to the purity of Walnut Creek which runs through the feedlot. Consequently, an Environmental Protection Agency grant was established in which the Environmental Protection Agency picked up 70 percent of the bill and Schram paid the other 30 percent in instigating a system to solve the problem. With the assistance of personnel from the University of Nebraska, the Agricultural Research Service and the Soil Conservation Service, a system was developed for runoff control. In the system that was developed, ten debris basins were located at the base of the feedlot pens to catch the initial runoff. A small orifice inside each riser screened out sediments from the liquids, allowing them to flow into holding ponds via underground PVC tiles. From the holding ponds, the liquid manure was fed into a center pivot irrigation system for disposal on croplands. Optimal disposal times were found to be prior to planting or after the crops were up 4-6 inches. This posed the problem of maintaining runoff holding capacity for a 10-year, 24-hour storm, but avoiding applying runoff to crops when they were vulnerable. Other problems that occurred were plugging of the orifices in the risers and deepening of the debris basins within the feedlot caused by cattle walking through them. Also, one year, a steer lay down on ice covering a debris basin. The ice melted and the steer drowned. While the system may not be problem free, at least it permits Mr. Schram to stay in business. (Merryman-East Central)

## 3513 - C2, F1

### WHAT'S MANURE WORTH?,

Successful Farming, Vol. 74, No. 11, p. 28-29, 47, October, 1976. 3 fig, 1 tab.

Descriptors: Nutrients, Chemical analysis, Economics, Costs.
Identifiers: Livestock wastes.

*Successful Farming* cautions against taking anyone else's figures in trying to figure out how much nutrient value is in livestock wastes for any particular feedlot. While livestock wastes have a monetary value, they also have wide variability in their nutrient content. This was exemplified by a study in which *Successful Farming* compared nitrogen, phosphorus, potassium, and percent solids in manure samples from 6 different farms. To get a good average sample, the lagoon or pit from which the sample is drawn should be agitated long enough to get all solids in suspension. The sample can be personally delivered to a laboratory for examination or it can be delivered by mail (preferably well-packed in a plastic container). Cost of securing such lab analysis varies. Labs checked by *Successful Farming* ranged from $12 to $22. Laboratories which provide such analysis are listed. (Merryman-East Central)

## 3514 - A11, A12, B1, B2, B3, E2, E3

### SOLVING THE FARM WASTE PROBLEM,

Veterinary Record, Vol. 95, No. 17, p. 399, 1974.

Descriptors: Waste treatment, Waste disposal, Diseases, Solid wastes, Liquid wastes, Slurries, Fertilizers, Recycling.
Identifiers: Carcass disposal.

At a meeting held by the British Veterinary Association Congress on September 18, 1974, Mr. A. F. Baldry reported on traditional methods of waste disposal, on the factors affecting choice of waste disposal systems, and on the transfer of disease by animal wastes. He stated that use of liquid slurry systems is on the increase and offers advantages of saving labor costs, reducing straw costs, and eliminating "mucking out". Factors affecting choice of a waste disposal system are: size of the enterprise, housing and feeding systems, type of land, annual rainfall, cropping policy, the possibility of water course pollution, health hazards, capital and running costs, labor requirements, nuisance value of odor, pipe moving in cold weather, and legal aspects. After discussing methods of disposal and treatment, Mr. Baldry went into the question of diseases which might be transferred by slurry, namely, salmonellosis, tetanus, anthrax, Q fever, Johne's disease, viral diseases, parasitic diseases, brucellosis, tuberculosis, leptospira and metabolic disorders. Most study has been done on the spread of salmonellosis. The case for the spreading of viruses has not been proved and requires more investigation. Mr. Baldry also discussed slurry as a fertilizer, slurry as a source of energy, manure as a feed, silage effluent, and carcass disposal. (Merryman-East Central)

## 3515 - A1, A3, B1, E2, F1

### AGRICULTURAL WASTES AND ENVIRONMENTAL POLLUTION,

Chief Soil Chemist, Soil and Water Conservation Research Division, U. S. Department of Agriculture, Beltsville, Maryland
J. Lunin
Advances in Environmental Science and Technology, Vol. 2, New York, Wiley, 1971, p. 215-261. 91 ref.

Descriptors: Pollution, Technology, Agricultural runoff, Erosion, Fertilizers, Insecticides, Herbicides, Salts, Minerals, Phosphorus, Nitrogen, Watersheds, Sediments, Salts, Minerals.
Identifiers: Pollution control, Livestock wastes.

We have adopted more intensified systems of livestock production, increased our use of agricultural chemicals, and expanded mechanization at a rapid rate, but only in recent years have we given consideration to the impact of this technology on environmental quality. Consequently, research to date has neither enabled us to assess adequately the effect of agricultural wastes on overall environmental quality nor to efficiently develop or modify technology to minimize pollution hazards. It is necessary to identify, quantify, and evaluate the significance of agricultural wastes in environmental pollution before efficient management practices can be developed for control and abatement. We need specific definitions of what constitutes a hazard in soils, water, plants, animals, or air from the various agricultural sources. Once criteria are established, management practices can be developed to achieve desired levels of pollution control and abatement. Existing management practices may be improved and new ones developed. Many problems can be solved by curbing runoff and soil loss. Existing erosion control practices, if universally adopted, would be quite effective, but these must be constantly modified to meet intensification of agricultural operations. Technology is needed for increasing fertilizer use efficiency. New technology is needed for safer and more economic disposal of animal wastes. Alternatives for use of persistent insecticides are being investigated. Use of herbicides will increase and new compounds developed must be evaluated for safety. New and improved methods for pesticides applications would help decrease pollution hazards. (Merryman-East Central)

## 3516 - B2, C1, D1

### PUMPING, MIXING, AND FLOW CHARACTERISTICS OF ANIMAL WASTES,

Agricultural Engineering Department, The University of Tennessee, Knoxville
J. I. Sewell, H. D. Bartlett and R. J. Smith
Presented at the 1974 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December, 1974, Paper No. 74-4542, 14 p. 6 fig, 11 ref.

Descriptors: Liquid wastes, Slurries, Pumping, Mixing, Flow characteristics, Management, Design, Recycling, Irrigation, Equipment, Cattle, Poultry, Separation techniques.
Identifiers: Flushing, Agitation, Swine.

Equipment and procedures for pumping and mixing liquid slurries of dairy, beef, swine and poultry manure are reported by 3 different authors representing the University of Tennessee, Pennsylvania State University, and Iowa State University. Topics under study by the University of Tennessee include: agitation and slurry irrigation of animal wastes, flow characteristics of poultry wastes, agitation of liquid beef wastes, agitation of liquid dairy wastes, and a liquid swine waste system. Pennsylvania State University is studying manure slurry pumping. Under study are: manure pit pumps, manure irrigation pumps, extrusion pumping, and solids-liquid separation. Iowa State University is studying liquid swine waste management. Under study are: recycling of lagoon liquor, coarse screening of lagoon liquors, hydraulic handling of poultry wastes, dewatering lagoons by pumping, and slurries flowing by gravity in pipes. Performance of the systems and design changes are discussed. (Rowe-East Central)

## 3517 - B2, C1, D1, D3

### RHEOLOGY OF AERATED LIVESTOCK WASTE SLURRIES,

Agricultural Research Service, U.S. Department of Agriculture, Department of Agricultural Engineering, Cornell University, Ithaca, New York 14853
A. G. Hashimoto and Y. R. Chen
Presented at the 1975 Annual Meeting, American Society of Agricultural Engineers, University of California, Davis, June 22-25, 1975, Paper No. 75-4038, 12 p. 6 fig, 9 ref.

Descriptors: Rheology, Slurries, Pumping, Mixing, Aeration, Equations, Centrifugation.

The objectives of this study were: (1) to identify a parameter that would mathematically describe the rheological properties of aerated dairy, poultry and swine waste slurries and that could be easily and precisely measured experimentally; and (2) to describe procedures to estimate the effect of rheological properties on pumping, mixing, and aerating livestock waste slurries. The study showed that the rheological consistency index (K) and rheological behavior index (n) of livestock waste slurries can be expressed in terms of the equilibrium sludge volume fraction ($\Phi_L$) as: $K = b_1 \Phi_L^{b_2}$ and $n = b_3 + b_4 \ln \Phi_L$ where $b_1$ to $b_4$ are constants. Values of $b_1$ and $b_4$ were determined for aerated dairy, poultry and swine waste slurries, and were found to be different depending on whether $\Phi L$ was greater or less than 20 percent. The relationships between K and n to the effective viscosity ($\mu e$) and generalized Reynolds number ($N_{Re}'$) were described along with the effect of $\mu e$ and $N_{Re}'$ on mixer power characteristics, oxygen transfer efficiency and pressure head loss in pipeline transport of slurries. Also described was a centrifugation method to determine $\Phi L$. This method is more precise, less time consuming, simpler and applicable over a wider total solids range than the previously reported quiescent settling method. (Rowe-East Central)

## 3518 - A1, A8, B1, E2

### USING CATTLE FEEDLOT MANURE TO CONTROL WIND EROSION,

Agricultural Research Service, U. S. Department of Agriculture, Manhattan, Kansas 66506
N. P. Woodruff, L. Lyles, J. D. Dickerson, and D. V. Armbrust
Journal of Soil and Water Conservation, p. 127-129, May-June, 1974. 2 fig, 2 tab.

Descriptors: Wind erosion, Equations, Weathering.
Identifiers: Erosion control, Surface-applied manure, Tilled-in manure, Anchored wheat straw.

The effectiveness of surface-applied and tilled-in cattle feedlot manure was compared with that of anchored wheat straw in controlling wind erosion. Feedlot waste containing 66 percent water was obtained from Kansas State University beef-cattle research feedlots and applied to plots at 4 rates (2, 5, 10, and 15 tons/acre, wet-weight) for surface-applied manure and 3 rates — 15, 30, and 60 tons/acre of manure disked into the soil. Except for the 2-ton surface manure, all treatments significantly lowered soil loss 2 days after application, and the 30 and 60 tons of tilled manure, the 15 tons of surface-applied manure, and all straw treatments were significantly more effective than were the 2- and 10-ton surface-applied and 15-ton tilled-manure treatments. The data indicated that at least 15 tons/acre of surface-applied manure and 30 tons/acre of tilled manure were required to reduce soil loss to less than a half ton/acre. This was 88 percent reduction from no-treatment, and it approached the 92 percent reduction attained with a half ton/acre of anchored straw. Equations were developed for use in designing wind erosion control practices. Curves were drawn for converting different amounts of surface-applied and tilled-in manure to their flat, small-grain wind erosion control equivalents. Overwinter weathering losses of surface-applied manure averaged 50 percent; tilled-in manure losses averaged 40 percent. (Rowe-East Central)

## 3519 - A2, B2, B4, D1

### RUNOFF CONTROL SYSTEMS FOR OPEN LIVESTOCK FEEDLOTS,

Extension Agricultural Engineer, Purdue University
J. C. Nye, D. D. Jones, and A. L. Sutton
Publication No. ID-114 (1976), Cooperative Extension Service, Purdue University, 1976. 8 p. 8 fig, 3 tab.

Descriptors: Agricultural runoff, Feedlots, Design, Settling basins, Infiltration, Indiana, Waste storage, Soils.
Identifiers: Runoff control, Holding ponds.

Runoff control can be accomplished on almost all livestock farms with settling basins, infiltration areas, or holding ponds. The size and type of components that are used can vary. This study has presented the basic design information needed to develop an effective system of runoff controls. To design a settling basins and infiltration channel area of the feedlot the soil type must be known. The settling basin is designed for the runoff from the 1-year, 1-hour storm which is 1.2 inches over most of Indiana. The infiltration area is designed to absorb the runoff from the 25-year, 48-hour storm which is 5.5 inches over most of Indiana. The holding pond cannot be emptied. The settling basin is designed to slow the runoff and allow the larger manure solids to settle. The runoff should be held in the basin for 15 to 30 minutes. The surface area of the basin is found by dividing the feedlot runoff rate by 4 cubic feet/hour/square foot. A surface settling rate of 4 cubic feet/hour/square foot has been found to be effective for settling the solids from feedlot runoff. The depth of the settling basin depends on how the basin is emptied. If liquid manure handling equipment is available, a wier notch would be used as the overflow. If the settling solids are to be handled with conventional solid manure handling equipment, a porous dam can be constructed of 2 x 6 lumber with a 1½" spacing between boards. The length of the dam should be about 2 feet. If long term storage of the settled solids is needed, surface area of the basin should be enlarged. If the settled solids will be handled with liquid manure equipment, the basin can be deeper than 2 feet. If a manure tanker will be driven next to the basin, the vertical sidewalls should be reinforced. (Rowe-East Central)

## 3520 - A10, A11, B1, C3

### SALMONELLOSIS IN CATTLE,

Veterinary Investigation Officer in charge of the Ministry's Veterinary Investigation Centre at Norwich, England
E. A. Gibson
Agriculture, Vol. 73, p. 213-216, 1966.

Descriptors: Salmonella, Cattle, Pathogenic bacteria, Treatment.
Identifiers: Great Britain, Salmonella dublin, Salmonella typhimurium, Clinical signs, Diagnosis.

Of the many types of salmonella which have been found in cattle, only 2 have been discovered in Great Britain to be of practical day-to-day importance — Salmonella dublin and Salmonella typhimurium. These 2 organisms behave quite differently. Though occasionally found in other animals, S. dublin is essentially a pathogen of cattle. S. typhimurium seems able to infect practically all species of birds and animals — and man with equal facility. While S. dublin seems to establish itself in certain geographical areas, S. typhimurium infection occurs in adult cattle throughout Britain. The 2 infections produce similar clinical signs in adult cattle — dullness, lack of appetite, high temperature, and profuse diarrhea with fluid feces that may contain mucus and blood. Both infections can produce a 'carrier' state for spreading the infection, but S. typhimurium is usually "carried' for a much shorter time. Prevention of the infection may be achieved by use of a vaccine that has been developed against S. dublin. The vaccine also helps prevent S. typhimurium infection. Certain management practices also may be employed, including placement of newly-purchased calves into clean, disinfected, isolated premises upon arrival to the feedlot. If salmonellosis is suspected in a batch of calves, diagnosis and treatment are, of course, matters for the veterinary surgeon, especially as laboratory examinations may be necessary to confirm the diagnosis and to test the sensitivity of the organism to various drugs and antibiotics. (Merryman-East Central)

## 3521 - A11, B3, C2, E3

### RENAL FUNCTION CHANGES IN LAYING HENS FED ON DRIED POULTRY MANURE,

Agricultural Research Council's Poultry Research Centre, King's Buildings, West Mains Road, Edinburgh 3H9 3FS, Scotland
L. Martindale and D. J. W. Lee
British Poultry Science, Vol. 17, No. 2, p. 195-197, March, 1976.

Descriptors: Poultry, Diets, Chemical properties, Performance.
Identifiers: Dried poultry manure, Renal function, Refeeding.

Three groups of 8 laying hens of the Warren-SSL strain were housed individually in battery cages with food and water supplied ad libitum. The hens, which had been fed on diets containing 0, 10 or 20 percent DPM for one year from point-of-lay, were allowed to continue on the same diets. The diets were made up on a least-cost-basis to contain DPM, 0, 100, and 200 g/kg; metabolisable energy 11·30, 10·38, and 11·46 MJ/kg; crude protein 163, 157 and 151 g/kg respectively, the true protein content of the DPM being used in the formulation of the diets. Renal function was studied in each bird after overnight fasting and, whenever possible, immediately after oviposition. Birds fed on 20 percent DPM showed increased rates of effective renal plasma flow and increased renal tubular secretion of urate during the infusion of large amounts of urate. Renal hypertrophy was not detected in any group. (Edwards-East Central)

## 3522 - B2, C2, D3, E3, F6

### METHANE GAS PRODUCTION FROM ANIMAL WASTES,

Department of Agricultural Engineering, University of Manitoba, Canada
H. M. Lapp, D. D. Schulte, and L. C. Buchanan
Publication 1528, Canada Department of Agriculture, 1974, 9 p. 1 fig.

Descriptors: Recycling, Methane, Anaerobic digestion, Canada, Design.

A dual-stage digestion system was installed at Glenlea Research Station, University of Manitoba in 1973. The system consists of 2 fiberglass septic tanks, 8 feet in diameter and 10 feet high, equipped with mechanical stirrers and internal hot water coils (35°C). These tanks hold 5.13m$^2$ slurry which is fed at 1.6 g VS/1/day with 20 day detention. The digesters yield gas of 60-69 percent methane, but fall below the expectations of 7 cu ft/day/hog. Pilot plant operational studies are continuing at the University of Manitoba to evaluate the technical and economic feasibility of producing methane from animal wastes by anaerobic digestion under Canadian climatic conditions. (Merryman-East Central)

## 3523 - A11, B3, C2, E3, F3

### UTILIZATION OF DRIED POULTRY WASTE IN CHICK STARTER RATIONS,

Department of Poultry Science, University of British Columbia, Vancouver, British Columbia V6T 1W5 Canada
P. Stapleton and J. Biely
Canadian Journal of Animal Science, Vol. 55, p. 595-607, December, 1975. 2 fig, 13 tab, 21 ref.

Descriptors: Rations, Performance, Poultry, Feed additive, Nutrients.
Identifiers: Dried poultry waste, Refeeding, Lysine, Methionine.

Dried poultry waste (DPW) from chicks fed a basal diet was formulated in chick starter rations, based on its chemical analysis, to ensure that all rations were equal in their true protein, fiber, calcium, phosphorus, and estimated caloric content. At 4 weeks of age, chicks fed rations containing 20 percent recycled DPW averaged 10 percent less weight than control chicks. Feed efficiency was found to decrease as DPW was refed. The addition of 20 percent lysine and 20 percent methionine increased the weights of chicks and improved feed efficiency by 6 percent when added to the DPW and control rations. The only important chemical changes that occurred in DPW recycled 5 times was the increase in fat level from 3.04 to 9.6 percent and the decrease in calcium and phosphorus levels from 1.94 and 1.88 percent to 0.88 and 1.10 percent, respectively. Amino acid composition remained the same. Twenty percent DPW rations elevated plasma uric acid levels to 5.7 mg percent, but no relationship between body weights and plasma uric acid was found. The mineral composition of the tibia of chicks was not affected by either the protein level or DPW in the ration. On the basis of results of the feeding trials and of the chemical analyses conducted, one cannot attribute the growth depressing effect of dietary DPW to a single factor. The lowered body weights may be due to a combination of factors or to a substance not revealed by the present analyses. Study results clearly indicate the need for further investigation of the nutritive and economical values of DPW in poultry rations. (Merryman-East Central)

## 3524 - B1, C2

### SOIL INGESTION BY CATTLE ON SEMIARID RANGE AS REFLECTED BY TITANIUM ANALYSIS OF FECES,

Soil scientist, Snake River Conservation Research Center, Kimberly, Idaho 83341
H. F. Mayland, A. R. Florence, R. C. Rosenau, V. A. Lazar, and H. A. Turner
Journal of Range Management, Vol. 28, No. 6, p. 443-452, November, 1975. 5 fig, 1 tab, 8 ref.

Descriptors: Grazing, Cattle, Titanium, Analysis.
Identifiers: Soil ingestion, Feces.

Soil ingestion was determined for cattle grazing a Bromus tectorum range in southern Idaho by measuring titanium concentrations in animal feces collected at 2-week intervals during the droughty 1973 grazing season. The experiment was based on the premise that titanium, which is abundant in soils, is contained only in small quantities (less than 1 ppm) in plants not contaminated with soil. Soil attached to aboveground plant parts did not seem to contribute much to fecal soil concentrations in the study. Fecal-soil concentrations in excess of 2 percent probably originated from soil adhering to ingested stem bases and roots or from direct soil ingestion. Fecal-soil concentrations ranged from 3 to 30 percent during the droughty 1973 season and generally increased as the amount of available forage decreased. Muddying of forage was definitely not a contributing factor in the Idaho study since soils remained dry during the July to November period. It was felt that fecal-soil concentrations in this study were probably related to closeness of grazing, forage availability, and shallow rooted plants. Cattle easily pulled the shallow-rooted cheatgeass plants from the dry silty soils along with portions of roots and attached soil. It was felt that soil ingestion may be important in considering the uptake of such toxic elements as cadmium, lead, mercury, pesticides and radionucleides, which are concentrated in the upper few centimeters of soil. (Rowe-East Central)

## 3525 - A4, A5, A8, B2, B3, C2, E2

### EFFECTS OF SOLID AND LIQUID BEEF FEEDLOT WASTES ON SOIL CHARACTERISTICS AND ON GROWTH AND COMPOSITION OF CORN FORAGE,

G. Wallingford
Ph.D. Dissertation, Department of Agronomy, Kansas State University, 1974, 293 p. 44 fig, 27 tab, 38 ref.

Descriptors: Solid wastes, Liquid wastes, Feedlots, Crop response, Corn, Salinity, Nitrogen, Water pollution, Groundwater pollution.
Identifiers: Land disposal, Loading rates.

A research project was begun in the fall of 1969 to study the effects of solid and liquid beef feedlot wastes on soil properties and plant growth. Corn was the crop chosen for study due to the large acreage of corn growth in the study area and because of its large yield and nutrient recycling potential. Beef-feedlot manure and lagoon water were shown to improve soil productivity when applied at rates that do not greatly exceed the capacity of the growing crop to remove nutrients contained in the wastes. Large amounts of either the solid or liquid materials retard corn growth. Salt buildup on the soil was thought responsible for the retardation. Electrical conductivity measurement of surface soil saturation extracts was found a reliable method to monitor salt accumulation. Loading rates based on salt content should not be used on a long-term basis because excess nitrogen will be lost out of the soil profile as nitrate nitrogen. Loading rates based on nitrogen content can be made on a long-term basis and are the most practical in conserving nitrogen and protecting the quality of groundwater and surface waters. (Rowe-East Central)

## 3526 - A8, B3, C2, E2

### EFFECTS OF FERTILIZER, BARNYARD MANURE, AND CROP RESIDUES ON IRRIGATED CROP YIELDS AND SOIL CHEMICAL PROPERTIES,

Research Station, Agriculture Canada, Lethbridge, Alberta T1J4B1
S. Dubetz, G. C. Kozub, and J. F. Dormaar
Canadian Journal of Soil Science, Vol. 55, No. 4, p. 481-490, November, 1975. 1 fig, 3 tab, 19 ref.

Descriptors: Fertilizers, Crop response, Soils, Chemical properties, Irrigation.
Identifiers: Barnyard manure, Crop residue.

Barnyard manure, N fertilizer, and crop residues (corn stovers and sugar beet tops) were incorporated into a Dark Brown Chernozemic soil singly and in combination in an irrigated four-course rotation (sweet corn, soft spring wheat, sugar beets, and sugar beets) that completed four cycles. Manure application at 27 t/ha every 4 years increased organic matter, nitrogen, phosphorus, and potassium of the soil and resulted in a 31 percent increase in the last-cycle yields of first-year sugar beets. When 66 kg N/ha were combined with the manure, the yields of first-year beets were increased 53 percent. Responses by second-year sugar beets were smaller. Each ton of manure used in the last 3 cycles of the experiment resulted in an average yield increase of 422 kg of sugar beets. Each application of 66 kg N/ha, as used in the last 3 cycles of the experiment, resulted in an anverage annual increase of 1.5 tons of sugar beets. The N fertilizer also increased the yields of corn during the third and fourth cycles, but corn did not respond to manure alone. The fertility treatments dd did not increase wheat yields. Incorporating sugar beet tops or corn stovers into the soil increased beet and corn yields but not wheat yields. The yields of sugar beets responded more to the residue treatments when grown without manure or N fertilizer than when the fertility treatments were included. (Merryman-East Central)

## 3527 - A11, C2, E3

### NUTRITIVE VALUE OF A SAMPLE OF DRIED POULTRY MANURE FOR THE LAYING HEN,

Agricultural Research Council's Poultry Research Centre, King's Buildings, West Mains Road, Edinburgh EH9 3FS, Scotland
J. M. McNab, D. W. F. Shannon, and R. Blair
British Poultry Science, Vol. 15, No. 2, p. 159-166, March, 1974, 6 tab, 27 ref.

Descriptors: Diets, Poultry, Nutrients, Performance, Phosphorus, Calcium, Nitrogen.
Identifiers: Refeeding, Dried poultry manure, Digestibility.

Two diets containing DPM as the sole source of nitrogen were prepared. Diet A contained 600 g/kg of DPM and diet B contained 995 g/kg. At the end of the experimental period for each diet, fecal and urine samples which had been taken from each bird were bulked, freeze-dried and weighed. The food, dried feces and urine were ground to pass through a 1 mm sieve and analyzed for total nitrogen by the Kjeldahl procedure. The composition of the DPM sample and the true digestibility coefficients of some of the components were determined. The true digestibility coefficients of the true protein, crude fat, uric acid, total organic matter and carbohydrate were found to be 64.2, 69.5, 91.2, 25.5 and 23.1 percent respectively by regression analysis of absorbed vs ingested nutrients. True digestibilities of some of the constituent amino acids ranged from 24.7 percent to 76.4 percent. The absorption of calcium and phosphorus was characterized of the individual bird and ranged from 1.2 to 45.3 percent for calcium and from 7.5 to 46.2 percent for phosphorus. It was found that ¼ to ⅓ of DPM was absorbed by the laying hen. (Rowe-East Central)

## 3528 - A11, B3, E3

## THE EFFECTS ON REARING AND SUBSEQUENT LAYING PERFORMANCE OF REARER DIETS CONTAINING TWO LEVELS OF PROTEIN AND DRIED POULTRY MANURE OR UREA,

Agricultural Research Council's Poultry Research Centre, King's Buildings, West Mains Road, Edinburgh EH9 3FS, Scotland
D. J. Lee, R. Blair and P. W. Teague
British Poultry Science, Vol. 17, No. 3, p. 261-268, May. 1976. 5 tab, 9 ref.

Descriptors: Performance, Diets, Urea, Energy Calcium, Phosphorus, Proteins.
Identifiers: Dried poultry manure.

An experiment was performed to determine whether 50 g dried poultry manure (DPM)/kg could be incorporated into rearer diets without adverse effects on subsequent laying performance. Two treatments were also included to test whether 10 g urea/kg added to rear diets would cause decreased food intake and could be used to regulate consumption. Six hundred and seventy-two light-hybrid, 6-week-old pullets were allocated to 8 experimental treatments and cage-reared to 18 weeks of age. In the 6-12 week period, 4 dietary treatments were applied. Diet 1 contained 160 g crude protein/kg. Diet 2 contained 160 g crude protein/kg with 50 g DPM. Diet 3 contained about 140 g crude protein/kg. Diet 4 contained about 140 g crude protein/kg with 50 g DPM. Two additional diets were also fed in which diets 1 and 3 were supplemented with 10 g urea/kg (diets 5 and 6). Diets containing DPM were formulated to utilize the crude protein, energy, calcium, and 50 percent of the phosphorus content of DPM. Pullets fed on high protein diets (1, 2, and 5) were significantly heavier at 18 weeks than those fed on low protein diets (3, 4 and 6). In the laying period, total estimated egg weight and food intake and conversion were significantly less. Dietary DPM had no significant effect on the 18-week body weight, but food consumption was significantly less and conversion was significantly improved. There were no significant effects on subsequent laying performance. Dietary urea caused no significant effects on rearing or laying performance. (Rowe-East Central)

## 3529 - B1, D3, F6

## MATHEMATICAL MODELLING OF ANIMAL WASTE TREATMENT,

Department of Agricultural Engineering, The University of Newcastle upon Tyne, England
J. L. Woods and J. R. O'Callaghan
Journal of Agricultural Engineering Research, Vol. 19, No. 3, p. 245-258, 1974.

Descriptors: Mathematical models, Waste treatment, Microorganisms, Separation techniques, Chemical properties.
Identifiers: Substrates.

Models that have been used to describe the dynamics of microorganism populations are surveyed. One model, that of Monod, is described in detail. The Monod model, a substrate model, is based on the assumption that the growth rate can be restricted by a shortage of any one substrate, This description, relating organism growth to a limiting substrate, appears to give greater insight into the physical situation than the alternative models, which tend to be more empirical and so limit extrapolation to treatment situations outside the specific test conditions. A comparison is made with experimental work, largely relating to pig slurry and leading to a formula for the prediction of the chemical oxygen demand of effluent supernatant. The effects of the feed concentration, the rate of flow, and the method of solids separation of the treatment process are discussed in light of the Monod model. (Merryman-East Central)

## 3530 - A8, B1, C2, E2, F1

## USING SWINE MANURE AS A FERTILIZER,

Department of Agricultural Engineering, University of Manitoba, Canada
D. D. Schulte and M. B. Tokarz
Presented at the Manitoba Hog Producer Meeting, Morris, Manitoba, March 1, 1976, 12 p. 2 fig, 5 tab.

Descriptors: Fertilizers, Nutrients, Economics, Nitrogen, Phosphorus, Potassium.
Identifiers: Land spreading, Swine manure.

The objective of this paper is to evaluate the relative costs of commercial fertilizers and manure fertilizers in a systematic and rational manner in an attempt to enable the pork producer to better assess the trade-offs between manure handling systems, the fertilizer value of the manure and the costs of commercial fertilizer. Results showed that a pig, from the time it is weaned until it is marketed produces about 7.2 pounds of nitrogen, 2 pounds of phosphorus, and 3 pounds of potassium in its manure. However, as much as 50 percent or more of the nitrogen contained in the manure is lost during storage and while spreading the manure. Additional nitrogen can be lost if the manure is not immediately incorporated into the soil. At today's fertilizer prices, and allowing a 50 percent loss of nitrogen, the nitrogen and phosphorus value of the manure is about $1.47 per hog marketed. The cost of using manure or fertilizer compares favorably with the cost of commercial fertilizer. A typical hog operation, growing and finishing 1,750 head per year and borrowing the capital to handle its manure, would have a net profit of approximately $0.24 to $.36 per hog by using the manure instead of by purchasing commercial fertilizer. Not taken into account in these figures are the facts that the manure would have to be handled anyway (even if it were not used as a fertilizer), and that manure has many beneficial effects on the soil which are not accountable in economic terms. (Rowe-East Central)

## 3531 - A11, B2, C2, D3, E2, E3

## CORNELL ATTEMPTS TO USE MANURE TO PRODUCE PROTEIN, REDUCE POLLUTION

Feedstuffs, Vol. 48, No. 49, p. 4, November 29, 1976.

Descriptors: Proteins, Fermentation, Aerobic conditions, Microorganisms, Bacteria, Yeasts, Feeds, Fertilizers, Energy.
Identifiers: Poultry wastes, Refeeding.

Professor Michael L. Shuler of Cornell's School of Chemical Engineering is principal investigator of a project, funded for 2 years with a $139,800 grant from the National Science Foundation, which will try to achieve the double objective of mass producing bacteria, and possibly yeasts, using manure as a growing medium. An aerobic fermentation process will be used in which air will be bubbled through the poultry wastes so that microorganisms can grow rapidly. The whole process should take about 6 hours with a continuous operation. It is anticipated that the microbial product would be fed to chickens as part of the regular diet, substituting for much of the conventional high-protein feed supplements. Energy value of the microbial feed product is yet to be determined. The solid residue that will be produced during the process can be utilized by spreading it on the land. (Merryman-East Central)

## 3532 - A8, B2, C2, E2

## USING LIQUID POULTRY WASTES IN WOODLANDS,

The Connecticut Agricultural Experiment Station, Box 1106, New Haven, Connecticut 06504

G. R. Stephens, and D. E. Hill
Proceedings of the International Conference on Land for Waste Management, Ottawa, Canada, October, 1973, p. 234-242. 3 fig, 5 ref.

Descriptors: Liquid wastes, Poultry, Nitrogen, Pine trees.
Identifiers: Land application, Woodlands, Plant response.

Liquid poultry manure containing 260 to 2,250 kg/ha N was applied at rates of 25 to 225 t/ha to plantations of white pine on well-drained and poorly drained soils during 1970-1972. Groundwater under plots receiving up to 115 tons/ha manure always contained less than 10 ppm $NO_3$-N throughout the study period. Groundwater beneath the poorly drained plot that received 225 tons/ha in 1970 contained as much as 80 ppm $NO_3$-N within 8 months of application, and still contained as much as 12 ppm $NO_3$-N after 27 months had elapsed. Storage of nitrogen in pine needles increased with increasing manure application and was 58 percent greater in heavily manured plots. Needle fall from all trees contained about a third to a half of the nitrogen in live foliage. Although manured trees returned more nitrogen to the soil in needle fall, they also retained more nitrogen in their crowns. After 3 years, relative growth rates of manured trees on the well-drained site had doubled. Manured trees of the poorly drained side did not experience a growth increase. It would appear that, assuming that 1,000 hens annually produce about 64 tons of liquid manure, 1 ha of pine plantation could safely utilize this manure on a sustained basis. (Merryman-East Central)

## 3533 - A5, A8, B2, C3, E2

## VERTICAL DISPERSAL OF FECAL COLIFORMS IN SCRANTON FINE SAND,

Department of Microbiology, University of Florida, Gainesville 32601
F. Dazzo, P. Smith, and D. Hubbell
Proceedings, Soil and Crop Science Society of Florida, Vol. 32, p. 99-102, 1973. 1 fig, 1 tab, 17 ref.

Descriptors: Coliforms, Sands, Slurries, Groundwater pollution, Sprinkler irrigation, Percolation.

A 91 cm plexiglass column lysimeter was used to study removal of coliforms from cow manure slurry percolating through sandy soil to groundwater table depths. The column was packed with Scranton fine sand obtained from a field adjacent to forage crops receiving cow manure slurry. Deionized water was added to the packed column to saturate the soil. In the first experiment, soil solutions were withdrawn from various depths within the lysimeter in order to analyze fecal coliform populations. In the second experiment, the remaining waste water was allowed to drain in order to determine the potential for groundwater pollution in contaminated soil due to a rise in the water table. Ninety percent of the fecal coliforms were removed from the slurry by percolation in the first 13 cm of the soil. Fecal coliforms could no longer be detected in the precolating slurry at a soil depth of 48 cm. Under these conditions, groundwater could become polluted from a legal standpoint in terms of its bacteriological quality if it rose to a depth of 38 cm. It may be seen then that vertical dispersal of fecal bacteria is a problem which should be considered and controlled in the design and operation of a waste treatment process involving sprinkler irrigation on land. (Rowe-East Central)

### 3534 - A8, C2, E2

### USE CAUTION WHEN SPREADING WITHOUT AMPLE MOISTURE,

Hoard's Dairyman, Vol. 121, No. 23, p. 1340, December 10 and 25, 1976.

Descriptors: Salinity, Soil water movement, Infiltration rates, Rainfall, Irrigation.
Identifiers: Land spreading, Application rates.

Maurice L. Horton of the Water Resources Institute at South Dakota State University advises against applying excess manure to soils that do not receive enough rainfall or irrigation water. In the research reported, application of beef feedlot wastes in excess of 20 tons of dry matter/acre in each of 3 consecutive years resulted in large increases of salts within the soil profile. With less than normal rainfall resulting in little or no leaching water, the effect of the increased salts was lower yields. Following 2 consecutive years of waste application, soils receiving more than 40 tons of waste/acre/year showed a substantial reduction in the ability to infiltrate water. Elimination of the waste treatment for one season resulted in increased water infiltration and reduced salinity due to rainfall and weather conditions. (Merryman-East Central)

### 3535 - B2, B3, C1, D3, E2, F6

### SORTING OUT SLURRY SYSTEMS,

M. Looker
Pig Farming, Vol. 21, No. 8, p. 68-69, 73, August, 1973. 8 fig.

Descriptors: Slurries, Waste treatment, Separation techniques, Equipment, Design, Biological treatment, Aeration.

Mr. John Hawkins of the National Institute of Agricultural Engineering (NIAE), Silsoe, Bedfordshire, England, feels that farmers with intensive livestock units and a limited amount of land need some form of treatment plant to help them dispose of the large quantities of slurry produced. NIAE is studying 3 types of separators with the aim of producing a farm machine that will separate slurry, which is difficult to handle and store, into a solid that can be stacked and spread more easily than farmyard manure, and a liquid capable of being stored, pumped, and treated without difficulty. These first-stage separators are all basically screens, although 2 have an additional component which squeezes or presses the fibrous solids from the slurry. Depending on the machine and its setting, slurries containing 8-12 percent dry matter are converted into a solid of 16-25 percent dry matter. This can form up to 40 percent, by weight of the original slurry, and can be stacked and spread. The remaining liquid is free-flowing and only contains 5-7 percent dry matter. On some intensive units, the liquid will need further treatment. Basically, 2 types of aerobic treatment plants are being studied by NIAE — biological filters and an aeration tower. A description of these plants is given. (Merryman-East Central)

### 3536 - B2, C2, D3, E3, F1

### WHERE THERE'S MUCK THERE'S GAS,

Rowett Research Institute
S. Bousfield, P. N. Hobson, R. Summers, and A. M. Robertson
Pig Farming, Vol. 21, No. 11, p. 79, 81, 83, November 1973. 4 fig.

Descriptors: Anaerobic digestion, Recycling, Gases, Costs, Economics, Pilot plants, Methane.
Identifiers: Piggery wastes.

Work has been instigated to develop an anaerobic digestion process for breaking down piggery waste on the farm. Pilot-plant experiments were carried out in a 100-litre continuously loaded, stainless-steel digester, heated to 95°F. The anaerobic processes were monitored. Results obtained from the pilot plant provided the basis for constructing a farm-scale digester. Experiments with the farm-scale digester are only in their early stages, but these, combined with the pilot-plant experiments, suggest that anaerobic digestion of piggery waste is possible on a large scale. The commercial feasibility of making gas by this process is debatable. The cost of the experimental digester vessel was 1300 pounds; the gas holder, 1200 pounds, and the heat exchanger, 450 pounds. Ancillary equipment: pumps, pipe-work, electrical work, boiler house with gas and oil boilers, storage tank, etc, 2000 pounds. Running costs are not yet worked out. If the process is considered primarily as a waste treatment, then the costs of this have to be met and production of usable gas can offset some of these costs. Future experiments will consider adding crop wastes and silage liquid to the animal wastes for gas production on the farm. (Merryman-East Central)

### 3537 - A11, B3, C2, E3

### NUTRIENT VALUE AND DIGESTIBILITY OF CATTLE MANURE AS A FEED INGREDIENT,

R. C. Hill
M.S. Thesis, Auburn University, December 10, 1975, 90 p. 21 tab, 154 ref.

Descriptors: Nutrients, Performance, Cattle.
Identifiers: Digestibility, Refeeding, Cattle manure, Ensiling.

Research was conducted to determine the feed replacement value of cattle manure when substituted into a balanced ration, to characterize the digestibilities of manure-containing rations, and to determine the effects of manure-containing rations on carcass quality. Forty-four steers were allotted by weight and breed to 4 treatment groups: (1) control — full fed basal mixture, (2) an ensiled mixture consisting of 80 percent basal and 20 percent wet manure collected from the feeding floor, (3) an ensiled mixture consisting of 60 percent basal and 40 percent manure, and (4) an ensiled mixture consisting of 40 percent basal and 60 percent manure. Animals were fed these rations for 112 days. Average daily gain (kg) and dry matter fed per unit of gain for rations 1-4 were: 1.21, 7.75; 1.29, 7.50; 1.33, 7.03; and 0.99, 7.45, respectively. Only at the 60 percent level of manure addition was daily gain significantly decreased. Feed intake was markedly reduced when 60 percent manure was added to the ration indicating a possible palatability or fill problem. The results of this study indicated that wet manure can be incorporated into a balanced ration at 40 percent and ensiled without decreasing gain, while improving feed efficiency. At this level of manure inclusion in the diet, 1 kg of dry manure was found to be equivalent to 1.5 kg of basal ration in respect to gain, and the calculated metabolizable energy of dry manure was 1.25 times that of corn. Thus, wet manure can be incorporated into a balanced ration, ensiled, and fed to finishing steers without any adverse effects on performance. There was also no adverse effect on carcass or flavor. (Rowe-East Central)

### 3538 - A6, B2

### DRY WEATHER MAY CAUSE LAGOON ODOR PROBLEMS,

Wallaces Farmer, Vol. 101, No. 21, p. 47, November 13, 1976

Descriptors: Lagoons, Odor, Pumping, Solids.

Many livestock producers with lagoons think 1976 was a great year for their operations because much of the liquid evaporated during the dry weather, allowing them to get by without pumping their lagoons down. However, Stu Melvin, Iowa State University extension agricultural engineer, fears that, because the lagoon solids became thicker, lagoon odors will be terrible in the spring. If lagoons are not properly diluted and then pumped down, solids will build up and shorten the lagoon's life. (Merryman-East Central)

### 3539 - A8, E2

### SUPPRESSION OF SUPERPHOSPHATE-PHOSPHORUS FIXATION BY FARMYARD MANURE. II. SOME STUDIES ON THE MECHANISMS,

Nuclear Institute for Agriculture and Biology, Lyalpur, Pakistan
M. Sharif, F. M. Chaudhry, and A. G. Lakho
Soil Science and Plant Nutrition, Vol. 20, No. 4, p. 395-401, December, 1974. 1 tab, 2 fig, 25 ref.

Descriptors: Phosphorus, Soils, Sampling, Chemical analysis, Crop response.
Identifiers: Farmyard manure, Superphosphates, Application rates.

Superphosphate was applied to a calcareous loam soil at rates of 98, 245, 490, and 2453 kg P/ha. $NaHCO_3$ extractable phosphorus was determined in all treatments; whereas, phosphate and lime potentials and various fractions of soil phosphates were determined only in treatment of 98 kg P/ha. The fertilizer treatments in quadruplicate were imposed in 3 ways: (1) superphosphate alone, (2) superphosphate and farmyard manure premixed at a 1:4 ratio, 24 hours before their incorporation into soil (premixed treatment) and (3) superphosphate and farmyard manure at a 1:4 ratio applied to soil separately (unmixed treatment). Soil samples receiving various fertilizer treatments were incubated at different time intervals, dried, ground to pass through a sieve, and stored in plastic bottles before they were analyzed. At all the time intervals, $NaHCO_3$ extractable phosphorus remained at a higher level in the premixed treatments than in the unmixed or superphosphate treatment only. The soil solution in the premixed treatments contained calcium phosphates of higher solubility than those in the unmixed treatment. The premixed treatment increased the soluble and Fe-Al phosphates at the expense of calcium phosphates. Results suggest that the increased uptake of phosphorus by plants from the application of superphosphate premixed with farmyard manure may have resulted from increased solubility of phosphorus in the pre-mixed treatments. (Merryman-East Central)

### 3540 - A11, C3, F6

### THE LIPIDS OF FOUR UNUSUAL NON-PATHOGENIC HOST-ASSOCIATED SPIROCHETES,

Department of Microbiology, University of Minnesota, Minneapolis 55455
B. P. Livermore and R. C. Johnson
Canadian Journal of Microbiology, Vol. 21, No. 11, p. 1677-1680, 1975. 1 tab, 11 ref.

Descriptors: Lipids, Bacteria.
Identifiers: Swine wastes, Spirochetes.

Lipid compositions of 2 spirochetes isolated from the human oral cavity and 2 isolated from swine feces were examined. The isolates were unusual because they required isobutyric and valeric acids rather than long-chain fatty acids for growth. Consequently, mediums free of serum or fatty acid-albumin supplements could be utilized in culturing them. The major fatty acids synthesized were normal and iso fatty acids with 14 and 16 carbons. No chain lengths were longer than 16 carbons. No unsaturated fatty acids could be detected. The major complex lipids observed were phosphatidyl glycerol, mongalactosyl diglyceride, and bis-phosphatidyl glycerol. Nitrogenous phospholipids were not snythesized. The data indicated an intermediate position of these isolates between *Treponema* and free-living *Spirochaeta*. (Merryman-East Central)

### 3541 - A11, A12, B2, C3, D3

### SURVIVAL OF LEPTOSPIRES IN CATTLE MANURE,

Department of Veterinary Microbiology and Public Health, College of Veterinary Medicine, University of Minnesota, St. Paul, 55101
S. L. Diesch
Journal of the American Veterinary Medical Association, Vol. 159, No. 11, p. 1513-1517, December 1, 1971. 1 fig, 1 tab, 16 ref.

Descriptors: Pathogenic bacteria, Model studies, Public health.
Identifiers: Leptospires, Oxidation ditch, Survival time, Health effects.

Research objectives were to measure leptospiral survival time: to develop and improve bacteriologic methods of measurement for detection of pathogens and for measurement of their survival in beef cattle manure in a laboratory model oxidation ditch during simulated field environmental conditions at summer temperatures; and to evaluate potential health effects of pathogens in cattle manure. Leptospires survived in manure in Selas candles for 6 days, in effluent for 5 days, in settling chamber sludge for 4 days, and in manure of the oxidation ditch for 61 days (preliminary). The oxidation ditch study was still in progress. Leptospires survived in well and stream water studies for 3 days. Disposal of beef cattle manure in the oxidation ditch model did constitute a potential public health problem. (Rowe-East Central)

## 3542 - A6, A8, B2, C2, D3, E2

## IRRIGATION SYSTEM DOES HIS MANURE DISPOSAL WORK,

R. Watkins, editor
Crops for Livestock, p. A-3-A-5, October, 1976. 4 figs.

Descriptors: Sprinkler irrigation, Liquid wastes, Lagoons, Aerobic conditions, Anaerobic conditions, Nutrients, Odor, Fertility.
Identifiers: Swine manure

Dave Streange, central Indiana volume corn hog producer, has developed a system for disposing of liquid hog manure through an irrigation system. A tractor PTO-mounted pump pulls liquid manure from a lagoon located next to slotted-floor hog confinement buildings with pits that empty into the lagoon. The liquid manure is pumped to irrigation sprinklers placed in an adjoining cornfield. Manure is disposed from 4,000 hogs with about 100 hours of labor a year. In winter the lagoon does not function. It simply becomes a manure holding pit from where full-strength waste is irrigated onto idle land. The irrigation system is capable of spreading 90 gallons per minute at 90 pounds pressure. The major benefit to the corn crop is the plant nutrients in the manure. There is quite a significant loss of nutrients through oxidation of the waste in the lagoon. About 80 percent of the fertility value is retained if pumped directly from the pit under the building to the land. Through the lagoon, only about 20 percent is retained. About the only problem with odor is in the spring when the lagoon changes from anaerobic to aerobic. At that time there are some gasses that are offensive, but it doesn't last long. (Rowe-East Central)